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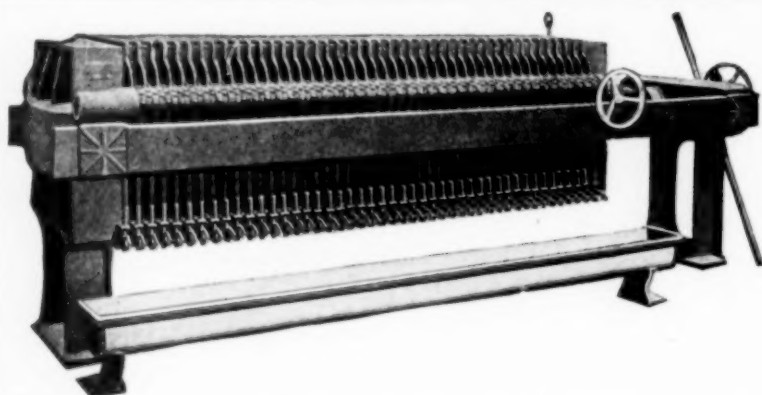
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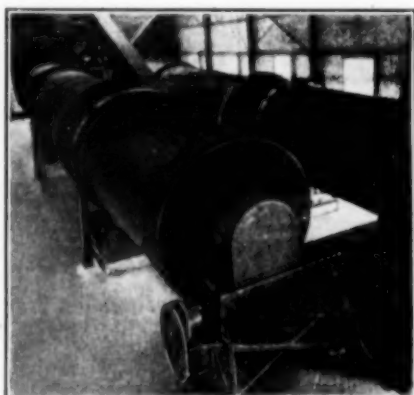
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Mineral Tariffs And Raw Materials

THE tariff on minerals involves certain economic and political problems not always considered in the usual protection vs. revenue controversy. What, for example, should be our attitude toward the continual exploitation of basic materials, the deposits of which are already rapidly approaching depletion? What should be our responsibility to American capital invested in foreign mineral supplies, and should we discourage these investments by surrounding our domestic industries with insurmountable tariff walls? Is the doctrine of free trade in raw materials applicable to our mineral industries?

Elsewhere in this issue is presented an unusual discussion of these important questions and the relation they bear to the proposed mineral tariffs. The article, representing only the author's opinions on this subject, is not to be construed as an expression of the editorial policy of this journal, but we believe that it offers a viewpoint of interest to all who are concerned with our mineral developments. To be sure, the detailed classification of some of the minerals may be questioned and many of the proposed tariffs do not warrant serious consideration. It is evident, too, that most of the rates have purposely been set at comfortably high levels in anticipation of later compromise and reduction. The general principles involved, however, apply no matter what rates are to be fixed by the new tariff law, and it is to this broader phase of the subject that CHEMICAL & METALLURGICAL ENGINEERING invites the comment and criticism of its readers.

A tariff on those minerals which because of geological limitations cannot be produced in sufficient quantities to supply the domestic requirements must necessarily raise the selling price of these products. As the producer's margin of profit is broadened, he will attempt to increase his output and will thus hasten the depletion of our limited domestic resources. This must be regarded as an extremely shortsighted policy, especially in the case of minerals of essential war- or peace-time uses. It would be more advisable, perhaps, for the Government to purchase and hold in stock sufficient supplies of these ores to carry us through another emergency.

With reference to the question of American capital invested in foreign mines, it is somewhat surprising to learn that these investments amount to almost a billion dollars and are continually increasing. Many of the proposed mineral tariffs will seriously affect the future return on these investments; in such cases the capital must be withdrawn or the mines operated solely for foreign consumers.

The third question raised by the author is the relation of our mineral supplies to the general and broader

consideration of raw materials. One of the lessons taught us by the late war was the serious economic effect of artificial barriers erected in the path of the free interchange of basic materials. The unrestricted ingress and egress of such articles would place the industries of all countries on a parity with regard to fundamental supplies and leave them dependent for their success as fabricators solely on their own skill and ingenuity. The free and unhindered development of the natural resources of the world represents a goal which can be attained only through the adoption of the broadest principles of national and international service.

Season-Cracking and Intergranular Fracture

COOKS and metallurgists have little in common. The better the cook's work the quicker it vanishes, but metallurgists build to endure—when they put a piece of metal into service it is expected to stay. Spontaneous fractures, occurring under moderate or even no load, are therefore matters of much concern; one cracked condenser tube is of more moment than thousands of sound ones.

Metals widely used in structures, utensils and machines all possess ductility to a certain degree; they deform appreciably before breaking. It has been shown that such normal or healthy fractures almost exclusively pass along crystal planes rather than between the grains which make up the metal. On the other hand, spontaneous fracture of drawn or spun brass goods while in storage, like cartridge cases, cups, jars, or tubes, has in all cases been found to be essentially intergranular. Fire-cracking, the damage done during annealing stamped utensils, is another manifestation of intergranular rupture.

Mysterious failures in other alloys have been studied in the past two or three years, and in nearly every case the crystals have given way at their borders; it therefore appears that season-cracking is a special case of a more general disease. To cite several instances, boiler plates have been found badly cracked at locations of somewhat concentrated forces after long service at the temperatures of superheated steam. Mild steel under low stress can be quickly fractured by immersing in hot chloride solutions. Corrosion, without any accompanying tensile stress, seemed to be responsible for the failure of an iron stirring rod used in a fused niter bath. Ductile metals break at crystal boundaries if tested at temperatures near the melting point. Pure copper develops intercrystalline cracks in a salt bath, and lead crumbles in the same way if exposed to certain weak acids. Furthermore, as is well known, fractures apparently the same as season cracks can be developed in brass articles by immersion in mercury solutions or exposure to ammonia gas.

Now, if these are all manifestations of the same group of phenomena, it is important to discover what is common to all; then see if that common cause is also a sufficient cause. That known, it can perhaps be avoided.

Tension stresses, either internal or imposed, are conceded to be the companion of all intergranular rupture. But why should a piece withstand the load for days or even years, and then give way? Why should a fracture imposed in ten minutes be transcrystalline, another in the same metal but in ten years be intergranular? ROSENHAIN says it is due to the fact that the amorphous intercrystalline cement is a highly viscous liquid, which, like pitch, deforms slowly even at low temperatures and under low loads, if these are prolonged a sufficient time; movement is more rapid as the temperature increases. Consequently fractures under prolonged stress will always be intergranular.

Pushed to its limit this theory would call for ultimate breakdown in all metal, no matter how small the load. Such a conclusion violates common experience and history. Consequently certain counteracting factors must exist.

The one most favored by Dr. ROSENHAIN is the interlocking of crystalline grains—if this condition exists, a small yield in the amorphous cement merely throws the load on crystal projections which can endure it forever. He believes that intercrystalline failure requires polyhedral grains bounded by quite smooth surfaces, a common condition in recrystallized metal. His recommendation is, therefore, to relieve internal stresses by a gentle anneal, but see to it that interlocked crystalline microstructure is retained. By all means avoid prolonged, high-temperature anneals.

But many annealed pieces must endure imposed tension stresses. Will they eventually rupture? It is doubtful. A second factor preventing this unhappy event is the probability that highly viscous supercooled liquids such as intergranular cement act in a truly elastic manner under moderate loads. Granted that a definite yield infers ultimate rupture in unsupported amorphous material, there is evidence that the time required to cause yield becomes infinite before the related stress approaches zero. Ten thousand pounds per sq. in. tension will not produce corrosion cracking within a measurable time in recrystallized brass having smooth grain boundaries. Even though some stress is necessary to produce season-cracking, it seems reasonable to suppose that the metal will endure at lesser stresses. In other words, no metal will break at any temperature unless loaded beyond the elastic limit of the amorphous phase at that temperature, regardless of its age, its composition or lack of crystalline interlacing.

But in many cases, if not in most, corrosion or chemical action at the crystal boundaries is the determining factor. Rarely surface corrosion or a scratch will disorganize the equilibrium of forces, building up localized and unsafe stresses, but this is only in rare cases. Reagents which cause true intergranular failure have been shown by MOORE in England and RAWDON in America to have a very superficial action—not penetrating the crystalline material, confined entirely to its grain boundaries, harmless unless external or internal tension stresses open up the cracks at the affected surfaces, providing the way for further entrance. On this basis time is evidently a controlling factor. A rough crystal surface also obstructs its progress.

But, as argued previously in these columns, there must be some essential difference between intercrystal-

line amorphous material and the amorphous material formed at gliding planes in overstrained grains. That lies either in the fact that the first is a very thick layer, while the latter is only a very few atoms thick, or that the disorganized metal at slip bands is precisely like that of its bordering crystal blocks, as far as chemical composition is concerned, whereas the non-oriented material at grain boundaries is the natural location of slightly soluble impurities. Such segregation may reach high concentrations even in normal practice, but especially in second-rate or over-annealed metal, and are certainly influential in causing the selective action of corroding substances.

It appears that chemical heterogeneity at grain boundaries has not heretofore been given the consideration its importance deserves. It accounts for failures by selective corrosion, which in turn requires time and tension. It is sure to be increased by long annealing even if no new impurities are added, by burning or overheating, since the existing ones will become more concentrated. It decreases the "melting point" of the amorphous phase, and consequently lowers its viscosity at all temperatures.

It may be argued that such chemical segregation is not a determining factor in intercrystalline failure, since it is a perfectly normal attribute of all metal. The same is true of stress. Quality metal, however, must be free of one or the other in order to withstand minute amounts of reagents so common as ammonia and salt. Since the reason for metal's existence is to do work or support loads, it follows that safety can be attained only by carefully controlling the microstructure and microchemistry of the crystal boundaries.

Dryness of The Liquid Phase

THE *Ironmonger*, an English trade paper, notes with regret in its issue of April 30 the disappearance of the corkscrew from British exports to the United States. The phenomenon is declared to be a sequel of prohibition. Little does the editor know his America! Laws are said to follow customs and public opinion, but customs in language and even processes of thought sometimes follow laws. Thus in the olden days a dry liquid such as wine was held to contain a minimum of sugar. The expression did not indicate that the wine was sour, but rather the absence of sweetness. Now, under the enlightenment of prohibition dry indicates the absence of a fermentation product of sugar and not of sweetness itself. Vast quantities of sugar are employed in the manufacture of beverages without affecting the meaning of dry. Out of prohibition also has grown the rule of physical chemistry in regard to dryness of the liquid phase, viz.: The dryness of a liquor varies inversely as to its C_2H_5OH content and directly as the mass.

Now, since all potable liquors are by law between 99.5 and 100 per cent dry the quantities consumed become very great and so do the number of stoppered bottles that contain them. The demand for corkscrews would therefore become greater than before were it not for the crown stopper and another reason which the editor of the *Ironmonger* misses utterly. This is the powerful thirst which has developed among Americans. It is held that a good American of the 100 per cent variety can easily draw the cork from a bottle of high-proof spirits by merely kissing it.

Can Opportunity Be Capitalized?

IN RECENT conversation with a thoughtful scientist he drew our attention to a present tendency on the part of some labor organizations to claim the right to work as their property. In this attitude they do not claim to represent all the people, but they are unwilling to submit their contentions to all the voters. They are a minority, but in some cases they propose to force their views on an unwilling public.

The point at issue and which must not only be decided but made clear one of these days is whether opportunity is property or not. We have prided ourselves in this country that every man has his opportunity free. It is a partial truth, like the lawyer's claim for equity in a day at court. But more men have had opportunity in this country, we think, than elsewhere. It is and always has been our ambition to make opportunity as nearly free as it can be made. The point at issue is how far opportunity may be capitalized and held to the exclusion of outsiders. We have property rights in houses, in bank accounts, in business, in good will, but we have held that every man is free to work.

The rule is not universal. In China they have property rights in houses, land, etc., just as we have, but also such rights in work. The coolie, for instance, is an outsider. He has no property rights in his labor, but he buys the privilege from the man that owns it, that has the concession. This same ownership is claimed by the officials of many labor unions. The tendency under unionism is to insist that work be farmed out to the unions just as the collection of taxes used to be farmed out. The unions select their members, decide what is fair or unfair, and use the power of siege to enforce their decisions.

Now, we favor the organization of workers for their welfare and protection. The selfishness of many employers has made that necessary. But does such organization provide ownership in the privilege to work? Let's take a stupid job like carrying a hod that requires neither training nor intelligence beyond a twelve-year-old mind. Is the opportunity to do this thing restricted to men who belong to the union? Many claim that it is; that the union is sole owner of the opportunity to work at the so-called craft, and that only its members may be employed. But *does* the union *own* the access to work that its members perform? It may and does hold possession, but is it the union's property?

Without of necessity thinking so (and we admit we do not think so), let's grant for the sake of argument that it is. Then the closed shop follows as a natural conclusion. The work is done under centralized, outside control which does not own the business or the machinery. The man who has work to be done and the man who wants to work for him cannot come together without authority which rests apart from them both, in the officials of a union.

There are more things to be done in nearly every country in the world than there are persons to do them. But if the opportunity to work is not reasonably free, then the work cannot be done. If opportunity is property, invention of labor-saving machinery must be brought to a stop as soon as general unionization ensues.

But if opportunity is not property; if the outsider, no matter who he is, has access to opportunity, there would seem to be a lack of equity in the closed shop. In the open shop the union must prove itself and do well. In the closed shop it is an absentee landlord.

Common Honesty And Self-Interest

ONE of the notable features of the present economic situation is the fact that some commodity prices are very much higher than others, judged either by their pre-war standards or by the production costs involved. In his very able discussion of the business and economic situation before the recent meeting of the American Iron and Steel Institute Judge GARY intimated that some sellers who are still holding their commodities at very high prices "ignore the principles of common honesty." Many may hold that it is taking new or advanced ground to declare that it is not honest for the ordinary seller to seek the highest price he can obtain or ask any price he has a mind to ask. Judge GARY is the head of a large corporation, and it is commonly held that a corporation large in its field should not charge an unreasonable price. Why should it be right for a seller small in his field to do so, when circumstances unprecedented have made it possible? Society always decides that what is not good for itself is wrong, and the great majority of men today believe that the continuance of high prices for some commodities, when prices of other commodities have greatly declined, is retarding the resumption of business activity, which would be for the general good.

Entirely apart, however, from "the principles of common honesty" is the question of enlightened self-interest. Is it wise, from the purely selfish viewpoint, for a seller to maintain high and unreasonable prices, simply by the fortuitous circumstance that all sellers of the commodity chance to be of the same mind and competition does not reduce prices? General business activity will not be resumed before all prices are adjusted, and if the completion of the adjustment is expedited all will benefit.

The common view seems to be that business will become active when the readjustment is completed—in commodity prices, in wage rates and in charges for service. It is by no means certain that resumption on the full scale will occur at once. Two things are required—the investment of capital and the spending of a large percentage of the normal or full income of the people. When there is much idleness, as at present, that income is greatly reduced. The normal buying power of the people must be restored, and that is a process requiring time and it is the duty of everyone to do what he can to help.

It has always been recognized that for the good of society all prices should be fair and reasonable, whether for commodities, for service or for plain work. Prices too low are as bad as are prices too high. Hitherto we have depended chiefly upon competition as the regulator, as is seen, for instance, by our being very jealous of suppression or partial suppression of competition by the acts of men; and more than thirty years ago Congress enacted a law fixing penalties and establishing methods of procedure in cases of "conspiracy in restraint of trade." In essence the Sherman law did not make such conspiracies illegal, as it was recognized that they were contrary to the common law; it prescribed what should be done. Present experience indicates that reliance upon competition as a corrective has broken down and society needs something more for its protection and welfare. Hence arise references to "the principles of common honesty" and the hope that enlightened self-interest will have a controlling influence where competition fails to operate.

Readers' Views and Comments

Easy Money From Peat

To the Editor of Chemical & Metallurgical Engineering

SIR:—A few days ago I learned from a friend of mine that a friend of his and several other gentlemen were investigating and seriously considering investing in a world-revolutionizing process which is none other than the one you exposed in the article "Easy Money From Peat" in *CHEM. & MET.*, Feb. 2, 1921, page 213.

I told him of your article, which he subsequently brought to the attention of his friend, with the result that the prospective investors will save their money for other purposes. I would have been glad to see a demonstration of the process, but when the investors asked for a demonstration they were told that none could be made now, as the amount of stock at present offered for sale had already been subscribed. The promoter evidently surmised that the would-be investors had discovered his game and he found it expedient to look elsewhere for lambs to be shorn. I thought it would interest you to know that the process is still very much alive.

CHEMIST.

Newark, N. J.

A Suggestion for the National Research Council

To the Editor of Chemical & Metallurgical Engineering

SIR:—The National Research Council, like every other organization at the time of its creation, to become a functioning body has to grope around and possibly crowd itself into some niche partly or wholly occupied by some other organization already in existence. Without doubt in the effort to find some one duty the National Research Council can perform better than any other existing organization a number of experiments will be tried which will wholly or partly fail.

At the present time the council is vaguely offering aid to American scientists—and I am writing this from the organic chemist's standpoint—in their research problems. I believe that this endeavor will have little success for several reasons. First, no scientist will disclose his plans sufficiently for the council to get an adequate idea what he is trying to do and its advice can be very general only. Directions in research work should be more specific than the directors of the Research Council will be able to give. Second, the organic chemist in the smaller schools doesn't usually suffer from lack of material and apparatus, but from lack of access to literature; therefore he will not take advantage of the offer to lend apparatus. Books to be useful must be readily accessible. If one is to consult a reference it is important that it can be done promptly. One can anticipate very few of his needs in literature references. For this reason I do not believe the experimenter in the smaller school can make use of the offer of aid in research.

One who has taught in a small school, which is often located in a small town, knows that the greatest need of the teachers is the stimulus obtained from meeting and hearing our able chemists. Sending them around the country makes them accessible to a few of us, but we aren't asking for charity so much as we are asking for

an opportunity. Would it not be feasible and worth while to conduct a series of meetings resembling the present teachers' institutes, to be held in a number of centers where we could spend a week or ten days during vacation periods and hear and meet a number of our prominent chemists? In addition to hearing these men we would have the chance to exchange ideas with men who are interested in the same work and the result would be an increased interest and efficiency and an increased amount of research work.

These institutes could be conducted in a business-like way with a charge which would cover or at least partly cover the cost of the undertaking. I am interested in learning what others think of such a plan.

Miami University,
Oxford, Ohio.

HARVEY C. BRILL.

Cost of Fixed Nitrogen

To the Editor of Chemical & Metallurgical Engineering

SIR:—In your issue of April 20 K. W. Jensen makes some comment on my article concerning cost of nitrogen fixation in the issue of March 23. Mr. Jensen states that his knowledge of the question is derived from a visit to Rjukan, Norway, and from theoretical studies. As I have been connected for twelve years with the Norsk Hydro-Elektrisk Kvælstofaktieselskab, which operates the factories at Rjukan and Notodden, and during this time have conducted the work of projecting and fitting up the firm's most modern plant, Rjukan Fabrik anlæg II (100,000 kw.), Mr. Jensen's experience does not impress me very much.

In explaining the Birkeland-Eyde furnace Mr. Jensen has the ill luck to make an erroneous statement. The disk of flame is *not* due to the action of *two* magnets, alternately charged and discharged, but to the action of *one* magnet, charged with *continuous* current, one pole at each side of the furnace. The extension of the disk at both sides of the electrodes is due to the fact that the *electrodes* are charged with alternating current. It ought not to be necessary for Mr. Jensen to travel to Norway to gain this knowledge, as he might have learned it from the technical literature. (Cf. Geoffrey Martin, "Industrial Nitrogen Compounds and Explosives," 1917, page 23; Jean Escard, "Production Industrielle Synthétique des Composés Nitrés," 1920, page 40; H. Ost, "Lehrbuch der Chemischen Technologie," 1920, page 168.)

Mr. Jensen writes that I ought to have made a lengthy explanation of the Birkeland-Eyde furnaces. In giving a short statement of the steps in the process the intention was to give information to readers who knew little of the subject, or, like Mr. Jensen, had formed mistaken notions. Is Mr. Jensen aware of the fact that at Rjukan Schönherr furnaces are used besides the Birkeland-Eyde furnaces?

I must maintain that in all types of electrical furnaces for the fixation of atmospheric nitrogen the electrical arc is given an increased area in order to heat the air by forming an enlarged heating surface. I presume that after all Mr. Jensen and I are of one mind about this point.

T. C. HAGEMANN.

Christiania, Norway.

British Chemical Industries

FROM OUR LONDON CORRESPONDENT

LONDON, May 17, 1921.

BUSINESS in the chemical markets is still mainly of the hand-to-mouth variety and the increasing number of works that have closed down on account of the coal shortage has naturally had a cumulative effect in reducing the volume of business transacted. The undertone both prior to the stoppage and even now is, however, favorable, surplus stocks are dwindling, and it is expected that, taking into account the practical cessation of German imports, there should be a healthy revival two or three months hence. The financial resolutions for the protection of industries bill have been duly passed by Parliament, but it is too early to predict the effect of the actual measure when it comes up for consideration after the holidays. The reparations bill, under which 50 per cent of the value of German goods imported is to be recovered, has so far produced only \$25,000, a figure which is a true measure of its failure to date. It is understood that the amount payable will now be reduced to 26 per cent on account of Germany's acceptance of the Allied ultimatum.

MANY PLANTS CONVERTING TO OIL FUEL ON ACCOUNT OF COAL SHORTAGE

The big oil-producing companies have been quick to seize the opportunity afforded them by the cutting off of supplies of coal and so far labor has not attempted to place an embargo upon the importation of fuel oil as in the case of foreign coal. By a suitable reduction in the price, oil fuel has for the time being become a serious competitor of coal, particularly in power plants and works situated some distance away from the main colliery centers. The ease and cheapness with which conversion can be effected has induced others to install oil-burning appliances as a stand-by for existing coal-fired installations and the natural result has been a boom in oil burners new and old, good, bad and indifferent. It is a little difficult for a great oil-burning nation like the United States to realize that the use of fuel oil in this country is practically in its infancy, but provided the present reduced price can be maintained, there can be no doubt of a steady increase in demand, which in its turn would react upon the price and also upon the supplies available in the future for American consumption.

"CHALKOAL"—A JOKE OR AN ATTEMPT TO GULL THE PUBLIC?

A further sign of the difficult industrial and domestic position occasioned by the coal stoppage is the crop of coal substitutes such as peat, logs, sawdust and briquets of all kinds which are being advertised for sale. A good illustration of the potential gullibility of the public and perhaps also of the promoters of the enterprise is the amusing advertisement and propaganda of the Chalk Fuel, Power Gas and By-Products Corporation, Ltd. This company proposes to supply blocks or ovoids of "Chalkoal," a mysterious "patented" substance manufactured under a secret process and stated to contain 70 per cent of chalk mixed with "10 per cent of a rich carbon substance subjected to special treatment" and the basis of which is coal tar. The preliminary announcement states that it is "a scientific fact that chalk by itself is not a satisfactory fuel [*sic*], but in

conjunction with other substances it has more fuel properties." A user is quoted as follows: "I find that in burning the briquet the gas which the chalk contains readily combines with the carbonaceous matter, and therefore gives you a combustible gas, giving off great heat, and double that of the ordinary household coal at from one-half to three-quarters less cost." The tragedy of it all is, of course, that the residue amounting to between 10 per cent and 33 per cent is a valuable byproduct threatening the cement and lime industries with extinction. Why the promoters should have kept the matter secret since 1914, when it was first "tested," is not disclosed.

CHEMICAL STONEWARE FIRMS RETURN TO PRE-WAR APATHY

During the war several manufacturers of stoneware undertook, at the request of the government, the production of chemical stoneware, and while the need remained urgent, valuable work was done and chemical stoneware almost equal to the pre-war German material was obtainable. The enormous demand shortly after the armistice for stoneware other than chemical stoneware caused most of these firms to abandon the less profitable manufacture of chemical ware, and as a result it is almost impossible to obtain reasonable deliveries, or any deliveries, at the present time, while with one or two exceptions manufacturers are asking exorbitant prices, probably with a view of discouraging the continuance of this class of business as being too much trouble. Supplies of German stoneware came into the market only to stop on account of the reparations act. The position has therefore become an interesting one and French, Belgian and even American stoneware is likely to be in demand in the near future. Curiously enough, an American firm, Bush, Beach & Gent, is acting as the British agent for the Deutsche Steinzeugwaaren-fabrik, of Friedrichsfeld, but judging by its advertisements in the press, the technical knowledge of its staff leaves much to be desired. It is generally thought that a progressive American firm able and willing to purchase an existing works in this country would soon find a ready field of activity in the chemical stoneware market, particularly if standardization were carried out as far as possible.

SIR WILLIAM POPE DEFENDS CHEMICAL WARFARE

In a closely reasoned contribution to *Chemical Age* (London), the president of the Society of Chemical Industry has once again displayed a fearlessness and independence of thought which has left some of his more staid and more conservative colleagues somewhat aghast. Not only is it claimed that the use of gas is less inhuman than other accepted forms of warfare—and this is effectively and humorously demonstrated by historical and practical evidence—but in effect it is shown that the most fatal weapon in the war was that of preventive medicine. By enabling millions to wage war and by depriving the non-combatants of the world of their meed of medical protection the responsibility for another and very large class of casualties is laid at the door of the medical profession. Sir William Pope, by his candor and innovations in other directions—for instance, by welcoming criticism as indicating a healthy tone in any society, by promoting joint local meetings of the Chemical Society and of the Society of Chemical Industry—has done more good than is realized by the "Old Guard."

The Tariff on Minerals

A Novel View in Opposition to the Policy of Tariff Protection for Minerals,
Based on the Present Status of Our Mineral Industries and on
the Effect of a Tariff on Their Development

By MARC PAWL

THE Ways and Means Committee of the House of Representatives has an exceedingly difficult job in trying to fix just rates in the new tariff bill that is to be introduced during the present session of Congress, for no man can know the conditions surrounding all the multifarious industries of this country, and no man can visualize the ramifying effects of a tariff. The difficulties are increased by the testimony and the briefs brought before the committee, for they are almost invariably highly colored by the desires of financially interested pleaders. In some of the briefs not a single fact is given without distortion, though a very few give fair and even scholarly presentations of their cases from the pleaders' standpoints.

In most pleas, especially by monopolistic concerns, costs, which ought to be the very foundation on which a tariff is erected, are carefully concealed, or excessively high costs covering the less defensible part of the industry are given, and the public is asked to grant a tariff to bolster prices, the justice of which is not shown.

In going over the reports of hearings before the Ways and Means Committee of the House, the unanimity of the emphasis placed on certain points is striking. Nearly all bills declare that they are "to provide revenue for the Government and for other purposes." One is to provide for the national security and defense, but I have seen one only that frankly states that it is merely to fix a duty on a mineral. One fears the Greeks who come bearing gifts.

Many of the pleas are for a tariff of 100 per cent or more of the price of the mineral or metal before the war, though some are less, and many have not yet reached the form of bills. Most of them ask for duties that will hold prices at or near the level reached during the Great War, but all show that the industry will not be overly enriched, and that the ultimate consumer will never know that his pocketbook has been touched.

Congress, in order that it might have less biased information than that introduced by special pleaders, provided for a Tariff Commission to investigate conditions governing the various industries, one of the most forward steps taken in tariff legislation in this country. This commission has done serious, hard work, but being composed of mortals, even as you and I, will require years to cover the huge and ever changing industrial world before it.

EFFECTS OF A MINERAL TARIFF

Perhaps no industry offers simpler conditions for weighing the application of a tariff than the mineral industry, and no industry except farming is more vital to our well-being.

General Hancock was, of course, wrong when he said that the tariff was a local issue. None but the immediate beneficiary has a local habitation. The payor is

every purchaser from Cape Prince of Wales to Key West, and the effect of a mineral tariff may be much more serious than the immediate effect it has in increasing the industry or raising prices.

Ore deposits are diminishing assets. They are like cisterns—they hold a fixed quantity, but unlike cisterns they cannot be filled again. The first production—that from the outcrop—is the cheapest, and as the deposits are worked to greater depth, or the richer ores are worked out, the costs become greater. The first deposits worked are usually the richest and nearest to transportation routes, and there is only one crop of ore.

On these truths, so axiomatic that they are almost trite, is built the mining industry, yet every appeal for a tariff is based on the assumption that these factors do not apply to the particular item under consideration. The plea is almost invariably made that if proper "protection" and "encouragement" are given, the industry will prosper, though the lack of prosperity may be due to lean deposits, inefficient operation and poor location, for ore deposits are where you find them and may be in very inconvenient places.

Never before has there been so good an opportunity for a proper estimation of the country's mineral resources as the present. During the Great War, the prices for minerals and metals reached heights unheard of. Prospecting took on new life, and men went over the country with a fine-toothed comb. Every possible outcrop was carefully examined and known deposits were worked to the limit. At the same time, governmental agencies gathered together all possible data thus made available.

OUR MINERAL RESOURCES AND PROPOSED TARIFFS

Although the United States is the richest mining country in the world, there are certain metals and minerals in which it is very poor, of which the principal are nitrates, the platinum metals, tin, nickel, soluble potash salts and diamonds. We have some of all of them, but by no possibility can we get enough for our needs from known deposits. If we think of our mineral resources as represented by a pyramid, these mineral products may be taken as forming the apex, thus approaching zero. If we imagine the lower part of the pyramid as curving so that at the bottom the sides become nearly horizontal, the base may be taken to represent our illimitable supplies of such minerals as salt.

Using such an idea, the minerals and metals on which duties are now being asked have been grouped in the accompanying table. The list is divided into two main groups: I. Minerals of limited quantity; II. Minerals in large quantity. Under the first group three divisions may be made: A. Minerals insufficient for domestic needs; B. Minerals insufficient for domestic needs ex-

MINERALS ON WHICH DUTIES ARE ASKED

	Proposed Tariff	Price in 1913
I. Minerals of limited known quantity:		
A. Minerals insufficient for domestic needs:		
1. Antimony ores.....	10c. per lb. contained Sb in ores, matte and antimonial lead.....	Best grade, 8.53c. per lb.
2. Cobalt oxide.....	75c. per lb.....	50c. or more per lb.
3. Tin ore.....	10c. per lb. 8n and 4c. on 8n in ore.	44.2c. per lb.
4. Graphite (lump and amorphous).....	Lump 3-6c., amorphous 2c. per lb.....	Ceylon lump 6.5-11c. per lb.; amorphous 1-1½c. per lb.
5. Diamonds.....	10% (incl. borts).....	
6. Iodine (resublimed).....	33½% ad val.....	
7. Nickel.....	10c. per lb.....	38c. per lb.
B. Minerals insufficient for domestic needs, except at artificial prices:		
1. Aluminum (bauxite).....	Al 7c. per lb., bauxite, not determined	
2. Chromite.....	60c. per unit.....	50% Cr ₂ O ₃ , \$10.12 per long ton.
3. Manganese ores.....	40c. per unit.....	\$7-\$12 per ton.
4. Monazite.....	15c. per lb.....	None produced.
5. Tungsten ores.....	\$10 per unit (20 lb.) WO ₃	\$7.50 per unit WO ₃ .
6. Pyrite.....	10c. per unit S.....	8.4c. per unit S (Virginia).
7. Mercury.....	50c. per lb.....	52.7c. per lb.
8. Graphite (flake).....	6c. per lb.....	6-8c. per lb.
9. Mica.....	Unrefd. 25c. per lb. and 20% ad val.....	37c. per lb.
10. Potash.....	50c. per unit K ₂ O.....	66c. per unit.
11. Vanadium.....	\$1 per lb. (in ore?).....	
12. Magnesite.....	Crude \$15 per short ton. Calcined \$25 per short ton.....	Crude \$7. Austrian calcined \$16.20 per short ton.
C. Minerals sufficient for the immediate future:		
1. Arsenic (white).....	5c. per lb.....	4.4c. per lb.
2. Barite.....	\$15 per short ton.....	\$1.71 per short ton.
3. Bromine.....	7c. per lb. plus 30% ad val.....	20.1c. per lb.
4. Fluorspar.....	\$5 per long ton.....	\$6.37 per ton.
5. Fullers earth.....	75c. and \$1.50 per short ton.....	\$9.58 per short ton.
6. Lead ores.....	3c. per lb. Pb cont.....	4.4c. per lb.
7. Molybdenum ores.....	50c. per lb. on MoS ₂ and concentrates.....	80% conc. 42½c. per lb. MoS ₂ cont.
8. Zinc ores.....	2c. per lb. Zn in ore.....	5.6c. per lb.
9. Feldspar.....	Not determined.....	\$3.31 per ton.
10. Sulphur.....	0.75c. per lb.....	0.8c. per lb.
II. Minerals in large quantity:		
1. Lime.....	\$1 per bbl.....	75.3c. per bbl.
2. Building and monumental stone.....	\$1 per cu.ft.....	
3. China clay.....	\$6 per ton.....	\$6.76 per ton.
4. Gypsum.....	50c. per ton.....	\$1.51 per ton.
5. Magnesium chloride.....	\$15 per ton.....	Fused, \$8 per ton.
6. Magnesium.....	10c. per lb. plus 15% ad val.....	\$1.65 per lb.
7. Flint (quartzite is used as a substitute).....	Not determined.....	
8. Pumice.....	\$20 per ton.....	\$2.26 per ton.
9. Talc.....	\$10 per ton.....	\$11.90 per ton.
10. Salt.....	\$5 per ton and duty on container.....	\$2.72 per ton.
11. Coal.....	75c. per ton.....	\$1.33 per ton at mine.
12. Phosphorus.....	17c. per lb.....	

cept at artificial prices; C. Minerals sufficient for the immediate future. It is probable that few if any of the producers will agree with the grouping, but the divisions are as indicated by the statistics of the United States Geological Survey.

A. MINERALS INSUFFICIENT FOR DOMESTIC NEEDS

All of the minerals of the first group are necessary in our commercial economy and will be imported no matter what tariff is placed on them. Tin ore, diamonds, and graphite in lump form are three mineral products that the United States lacks almost entirely.

We do have some amorphous graphite, to which reference will be made again. Flake graphite is put in the second group.

ANTIMONY ORES

Our experience during the war showed that sufficient antimony to supply the needs of the United States cannot be produced from our known deposits at five times the price of 1913, the last normal year, or seven times the present price of 5.5c. per lb. Even at a price of 14 to 16c. which the proposed tariff would probably put on the metal, it is likely that not over 500 of the 7,500 tons normally used in this country could be produced. Ten cents per lb. above the normal market price for

7,500 tons would be \$1,500,000, that someone would have to pay as a tax, although the revenue that the Government would receive would be \$100,000 less. Besides the deposits in our own country, Americans own considerable antimony deposits in Mexico.

COBALT OXIDE

Cobalt oxide is produced in only one mine, that at Fredericktown, Mo. Queerly it is controlled by Canadian capital, and Americans produce much more cobalt ore in Canada.

TIN

We produce not more than 200 tons of tin concentrate per year, say 135 tons of tin, and we can not enlarge this notably. The war put a price of 75c. to \$1 a pound on tin for a considerable period, but production did not increase. Great Britain, through her assiduous and long-continued collection of unprotected territories, has acquired about 50 per cent of the world's tin deposits, not including Siam's, which she also virtually controls, but the United States, a non-producer, uses about 80,000 short tons (1918 figures) out of a world's production of 131,000 tons, or more than 60 per cent, and it seems possible to control commercially only a part of the ore necessary. The largest independent miner of tin ore is Bolivia, which produces 28,000 tons of tin in ore that is shipped to other countries for smelting, equivalent to more than one-third of our requirements, and it is possible that more ore may be mined under the initiative of outside capital.

Years ago the spectacle of American tankers carrying kerosene to Asia and coming back empty moved some American capitalists to build a tin smelter at Bayonne, N. J., with the idea of smelting tin concentrate to be brought back by the tankers from the Malay Peninsula, but a British company had a smelter at Singapore and the government promptly placed a 33½ per cent export tax on the ores and the smelter at Singapore continued a strict monopoly. The Bayonne smelter was put out of business, but five others have grown up, and all the Bolivian ore can now be handled here, though much of it goes to Europe and Singapore. Excellent electrolytic tin, apparently fit for all purposes, is now made here. A tariff on ores will give revenue, but cannot build a tin mining industry.

It must be remembered, however, that the United States cannot buy ore sufficient for her needs, for she uses 60 per cent of the world's output, and, including Siam's output, Great Britain controls nearly 60 per cent.

A duty of 10c. per lb. on tin would make an extra cost of \$3 a ton on tin plate, and unless a rebate were allowed on export material, this might readily kill the export trade. Americans, however, would have to pay the increased cost.

Americans have several million dollars invested in tin mines in Bolivia and other millions invested in tin mines in the Federated Malay States and China.

GRAPHITE

This country has no deposits of lump graphite, from which the best crucibles are made, but imports its supplies from Ceylon, the one great producer, and Americans are interested financially in Singalese deposits. Our American deposits of amorphous graphite are not to be compared with the deposits in Sonora owned and operated by Americans. These deposits formerly fur-

nished and probably yet furnish the graphite for the best lead pencils of both domestic and foreign make. The heavy duty proposed, about 100 per cent on flake graphite, is probably aimed at the Madagascar flake, which really competes with the American product, but the tariff on amorphous graphite is from 167 to 200 per cent of the 1913 prices.

DIAMONDS

The problem of the diamond is only a phase of the "woman question." The diamond millionaires of Great Britain, forming one of the most rapacious and complete monopolies known, were created and are kept growing by the American bride-to-be. Her solitaire is usually far more expensive than the young man can properly afford, and the price is maintained and kept up to all the traffic will bear. The mass of diamonds are indefensible luxuries for which prices beyond all reason are charged and paid to satisfy mere whims, so that no objection can be made to a tariff of any sum. A smaller part of the diamonds imported are for serious use. (It is not, however, intended to suggest that being a bride-to-be is not a serious matter!) They are the borts or imperfect stones and the carbons or amorphous diamonds, and are used in diamond drilling, glass cutting, etc., and a duty on them is a tax on necessities and especially on mining. The prices for these stones reflect the prices on gem stones and are out of all reason, even without a duty.

IODINE

Iodine has so far been produced only experimentally in this country. It comes from Chile, where it is obtained as a byproduct from the nitrate deposits in which American firms have millions of dollars invested, and can be produced in quantities far beyond the world's needs.

NICKEL

The suggestion that a tariff be placed on nickel is probably not to be taken very seriously. The richest nickel deposits in the world, those of Sudbury, Canada, are largely held by the International Nickel Co., an American company, and this company also supplies the larger part of the world's manufactured nickel. The investments of the company in Canada are valued at many millions. Under no imaginable circumstances could the United States supply its needs of the metal.

On none of the minerals of the first group except diamonds for gems does a tariff seem justifiable.

B. MINERALS INSUFFICIENT FOR DOMESTIC NEEDS EXCEPT AT ARTIFICIAL PRICES

In the group of minerals insufficient for domestic needs except at artificial prices are several minerals of which it is conceivable that if the price were high enough the entire needs of the United States might for a short time be supplied from domestic mines. During ordinary times, however, it has been found expedient to import a considerable part of our supplies, the proportion varying from almost the total quantity of potash to a comparatively small part of our flake graphite and mercury.

With the exception of monazite, this group of minerals was of enormous use in carrying on the Great War. Except for aluminum, graphite, mica and pyrite, these minerals were almost or quite irreplaceable by substitutes. We have not yet joined the League of Nations

and there is as yet no insurance against war. Few thought the Great War possible, another may be nearer than we think.

Using for our nation the same sort of thoughtful care that we do for our families, what must be our attitude toward these deposits, the depletion of which, comparative or total, is apparently only a handful of years away?

BAUXITE

An important item that must be stressed when considering the cost of minerals is the matter of purity. Thus American bauxite ordinarily carries from 8 to 9 per cent SiO_2 , against 2 to 3 per cent SiO_2 in good foreign material, and only 55 per cent Al_2O_3 , against 62 per cent Al_2O_3 in the foreign ore. These differences are equivalent to an added cost of several cents a pound to the manufacturer if he must use the lower grade mineral. The same reasoning applies to chromite and manganese ores, to monazite and pyrite. The mass of domestic ores are of lower grade than the imported ores, and if the American metallurgist is compelled to use them either he must bear the added expense of reduction, or he must pass the cost along with the duty to the ultimate consumer—to you and to me, and to William Jones and John Brown, who are so lost in the crowd that, like the grains of sand on the beach, we blend in blurred obscurity unless someone stoops to look at us.

CHROMITE

Under the desperate needs of the Great War we produced 82,350 long tons of chromite averaging 50 per cent or less Cr_2O_3 at \$48 per ton, but at the same time we imported more than 100,000 long tons averaging 50 per cent or more Cr_2O_3 at \$28.88 per ton. That is, we produced four-ninths of our needs at a cost one-third higher than that of the five-ninths imported. Not only were the actual costs higher during the war, but an indirect cost was added of which little account was taken. That was the excess of cost in working lean concentrates, of which I have just spoken. At a time when every pound of coal and every bit of electrical energy was so greatly needed, we had to waste a great deal of it in slagging off useless rock. This was a tax as burdensome as the higher prices, but invisible to any but the metallurgist.

MANGANESE ORES

Almost the same conditions applied to manganese ores. Our own deposits were mostly small and mostly poor. Some high-grade deposits were developed and some are now known, but they are very much smaller than our needs, and must have high prices to work successfully. The manganese deposits associated with the copper ores at Butte (rhodochrosite) and Phillipsburg, Mont., are large, and water power is conveniently developed, but mining is expensive and the ore is not the cheapest to reduce. But even under war conditions, we cannot produce the ores we need, and under peace-time conditions higher grade ores at much lower prices can be readily obtained from India, Brazil and Russia.

Americans own large manganese deposits in Brazil, and other deposits are owned in Mexico and India, involving investments of probably \$5,000,000.

MONAZITE

The proposed tariff on monazite is another case of a proposal to compel the use of American material of lower grade and higher price. The marketable mona-

zite from the Carolinas carries only 4.5 to 5.5 per cent ThO_2 , against about 6.5 per cent in the Brazilian monazite, and 8 to 9 per cent in that from Travancore. If the bill passes, either the waste of chemicals and the extra freight and labor costs required to use the American material or trebled cost for foreign "sand" must be faced. It is worth mentioning that John Gordon, an American, is the principal Brazilian monazite producer.

TUNGSTEN ORES

Tungsten ore is another particularly bad subject for a tariff. In 1917, under prices at least three times the normal and which had existed for two years, we were able to produce a little more than one-half of our needs. In 1918, under similar prices, we produced one-third of our needs. Under a price of \$17 per unit, two and one-half times the normal price before the war and the price which it is hoped will be reached under the proposed tariff of \$10 per unit, it does not seem probable that the United States can produce more than 3,000 tons per year for three years from the deposits now known. Indeed this seems a rather optimistic estimate. Remembering the intensive prospecting of the war period, we have no reason to expect the discovery of deposits that will greatly alter the situation.

Americans own tungsten deposits in Bolivia, Mexico, Portugal, Argentina, Korea and Siam, worth probably a million dollars. The imposition of a tariff will, of course, prevent their shipping their ores to this country.

PYRITES

Before the Great War most of our sulphuric acid plants were fitted to use pyrite only, and great cargoes were brought from Rio Tinto, Spain, to supplement domestic supplies. Huge quantities of acid are made from waste gases from smelters, and sulphur is now being burned in large quantities for acid making. The usefulness of sulphuric acid depends largely on its cheapness, and a high degree of civilization demands cheap sulphuric acid, but tariffs on pyrite and sulphur mean dearer acid. In their need for pyrite, Americans were forced to buy pyrite mines in Canada and have considerable money invested in them. Their output will be affected by the tariff like any foreigner's product.

MERCURY

Of mercury the United States mines about half of the world's supply, but according to testimony before the Ways and Means Committee our ores carry only about 8 lb. to the ton and our cost is 93c. to \$1 a lb. According to the same testimony, Spanish quicksilver is produced at a cost of 50c. per lb. During the Great War, the price of mercury reached \$125.89 per flask of 75 lb. If the figures for costs of production are accurate, American mercury cannot compete with foreign mercury even under the proposed tariff, for it certainly cannot be put on the market at less than 20 per cent gross profit. This added to the cost of \$70 to \$75 per flask will make a price of \$84 to \$90 per flask. The Spanish producers, if their costs are given correctly, should at the same rate of profit be able to lay their mercury down in this country at slightly less. Either the figures are wrong or the tariff proposed by the miners will be futile. For years American mercury has been sold for export at \$5 per flask under the domestic price.

FLAKE GRAPHITE AND MICA

Of flake graphite the deposits of the United States are comparatively large, and Americans are known to be interested in flake graphite deposits in Canada. The Madagascar flake is better than the American, and will probably be imported in spite of a tariff, the duty merely adding to the user's troubles.

Mica is mined from pegmatite dikes and like all pegmatitic minerals is proverbially in uncertain quantity. The mining of mica in this country has always been so precarious that large users have invested in Canadian deposits in order that they might be sure of their supply. No one can foresee or foretell what the future supply will be. It is peculiarly an industry adapted to countries like India, where labor is cheap. Prices for mica have always been very high, and with the advent of the great electrical industry they have become higher. It is at present a small industry employing very few persons.

POTASH

So far very few deposits of soluble potash salts have been found in the United States. They are confined to the small brine lakes of northwestern Nebraska, the salt fields in Great Salt Lake Desert, and Borax Lake in the Mohave Desert, California. There is no likelihood of our being able to supply our needs from these sources. More laboriously, potash is being obtained from kelp along the Pacific Coast, from the dusts of cement mills, from wood ashes, from alunite and from green sand marls of the Coastal Plain. Experiments without number have been made on the production of potash from the feldspars and other silicates, but to date these have not met with commercial success, though the use of glauconite is promising. We are still, and probably will be for a good while, dependent on the German and French deposits for a large part of our potash. The proposed tariff will add 75 per cent to the cost of potash, and may encourage continued experiments on the extraction of potash from the silicates. Potash is used mostly in fertilizers that are used in farming, the most poorly paid of the basic industries, and by the farmer must the cost of the experiments be paid. The passing along of the tax is in his case a grim pleasantry, for he does not and cannot fix the price of his products.

VANADIUM

The proposed vanadium tariff is probably not to be taken too seriously. More than half of the world's vanadium comes from the unique deposits at Minaragra, Peru. The deposits are American owned and operated, and recently changed hands at a price of \$3,000,000.

Our own vanadium deposits are mostly in southwestern Colorado and southeastern Utah. A large part of the output is made as a byproduct from radium ores.

It is likely that at recent prices we can supply most of our needs for five years or more from the known deposits.

MAGNESITE

Under normal open market conditions, magnesite has been a comparatively cheap mineral, but it is heavy and bulky. The American mines are located in California and Washington, but the principal users, the steel mills, are located from Chicago eastward to Buffalo. The California deposits are comparatively small, and for many years were worked with the tacit acknowledgment that without an unreasonable tariff they could not well

compete with the Austrian magnesite on account of the much greater size of the Austrian deposits and the high freight rates from California to the Eastern steel mills. Before the Great War it was not always easy to get supplies of magnesite as they were needed and one of the large American magnesite brick manufacturers bought an Austrian deposit and invested altogether \$1,000,000 in the project. Other Americans bought and operated magnesite deposits in Venezuela, Lower California and Canada.

In 1915, the year following the outbreak of the war, when all imports were cut off, Austrian calcined magnesite was selling for from \$25 to \$26 a ton in New York, and brought as high as \$60. The deposits near Chewelah, Wash., were rediscovered, and the high prices and shortage of magnesite offered an excellent opportunity for their exploitation. One company made an investment of nearly a million dollars and another company made an investment of half a million. At the prevailing prices and shortage of the material even the California deposits were enabled to ship to the East, and large developments were made. But the war came to a close and left the large Washington investments unamortized. With the cessation of hostilities in Europe, the usual sources of magnesite again became more or less available, and railroad freight rates had meanwhile increased largely so that neither the Washington nor the California operators would have been able to ship magnesite in competition with the European producers, even had the demand not collapsed with the steel business. It is now proposed that a duty of \$25 per short ton of calcined magnesite, equivalent to more than 150 per cent ad valorem, be levied, making the price to the Eastern consumer at least \$41 per short ton of calcined magnesite, and probably nearly as high to the Western buyer.

On the crude magnesite a duty of \$15, or more than 200 per cent, is proposed, making the cost at least \$22 per ton. Should the consumption be equal to that of 1913, it would be equivalent to 172,591 tons of calcined and 161,967 tons of crude, on which would be levied a total tax of \$6,740,000. It is explained that the cost is distributed over so many tons of steel that it will be unnoticeable. It will, however, put out of business the Americans who have invested in mines in foreign countries.

The proposed tariffs are so high that, if put into effect, they may defeat their objects, for at these prices it seems possible to make profitably an artificial magnesite and thus leave the Western mines without their market.

BAUXITE AND ALUMINUM INDUSTRY

It is impracticable to consider the tariff in relation to all the minerals as such and without regard to the manufactures from them; thus bauxite must be considered with aluminum. In the United States the aluminum industry is centered in a single company. It owns most of the American bauxite deposits and controls most of those in the Guianas—the best and largest known. This company, the Aluminum Company of America, has a monopoly of aluminum production both in the United States and Canada, and in 1919 its capacity in the United States was 90,000 short tons of the world's plant capacity (exclusive of Canada) of 270,000 tons, and including its Canadian plant, possibly 210,000 tons, or about 70 per cent of a total of 310,000 tons. It has kept free from competition probably as closely as any other American company.

It has net assets of more than \$110,000,000, apparently mostly derived from earnings.¹ Inquiry along this line at the tariff hearings was not allowed to proceed. The representative of the company admitted that it had had, through its Canadian branch, a selling agreement in Canada and Europe which on account of the law did not apply to the United States. The cost of manufacture is supposed to be from 12c. to 13c. a lb. The selling price is from 28c. to 30c. a lb. In the committee hearings no data were brought out or asked for on this point. In its brief the company speaks of using only Arkansas bauxite of low grade, although in British Guiana the company owns the finest known bauxite deposits, and has brought in large quantities of the ore.

A tariff on bauxite means a burden on any company that might have the temerity to try to compete with the Aluminum Company of America, and further profit to the present monopoly. Aside from raising revenue, it can do no good. The company manufactures aluminum products and a tariff on the metal means more profit to the company, added cost to competitors in the manufacture of aluminum articles, and added cost to the consumer.

IMPORTANCE OF SOME ORES IN MODERN WARFARE

Manganese, chromite, quicksilver and tungsten are indispensable in modern warfare. Without manganese the making of steel is immensely more difficult; without chromite armor plate is useless and tool steels sink to a level little higher than carbon steels; mercury makes our best percussion caps, and without tungsten high-speed steels we would have been unable to equip enough factories to turn out our munitions in the Great War.

It is possible that very high artificial prices may cut part of the metals off from some of their most useful though as yet unproved applications. This may be shown by chromium. Stainless steel, an alloy of 13 to 17 per cent chromium with iron, is remarkably resistant to rust and seems to offer great possibilities of usefulness. As an example, concrete sea walls now destroyed by the rusting of the steel reinforcement would probably stand indefinitely were stainless steel bars used for reinforcement. The extra cost for such material would be much less than the cost of replacing the walls.

In many oil wells the pipes are destroyed by corrosion long before the well is exhausted. In certain favored wells it seems possible that a stainless steel casing could be used. The present cost of the chromium in a ton of such steel would be from \$40 to \$50 per ton, and must be near if not above the limit of cost. The heavy duties asked may well be the deciding factor for such possible uses.

In proposing heavy duties on these minerals, the plea has been that there is great need of home development so that the Government might have the necessary quantity of the minerals in case of another war, and that the mines should be kept in a state of development so that the ores could be quickly obtained and that if the mines were allowed to close they would be flooded and ruined.

This is merely plausible sophistry, for no man will develop ore bodies to let them stand for the Government's convenience. Development means depletion, and a tariff on the ores means a premium on early depletion. Flooded and caved mines are bad, but exhausted

¹Hearings on general tariff revision before the Committee on Ways and Means, House of Representatives, Pt. 2, pp. 894-921.

mines are useless. If the Government held in stock supplies of these ores large enough to carry us through a considerable period of another great war, such a situation could be faced with more equanimity.

MINERALS SUFFICIENT FOR THE IMMEDIATE FUTURE

In the group of minerals the deposits of which seem to be sufficiently large to furnish our needs for an indefinite time are two of the principal industrial metals—lead and zinc; two elements usually recovered only as byproducts—white arsenic and bromine; molybdenum, a metal apparently just finding its use; and a number of non-metallic minerals, particularly sulphur. Of lead and zinc the United States is the largest producer. The only difference between the minerals of Group C and Group B is that our supply is larger, but the end is just as definite and as certain to be reached.

If I understand the pleas for a tariff on zinc aright, however, it is not that we cannot produce in competition with the world, but that many of our poorer mines cannot compete. So far as I know, no figures of costs are given for the Franklin Furnace mines nor for the best of the northeastern Oklahoma mines. For many poor mines undoubtedly the costs are higher than the market price, but that would be true if the price were a dollar a pound. The principle advocated seems to be that when once a camp is started the tariff should follow rising costs in order that the operators may continue to make money until the zinc ore is all mined. If for poor zinc mines, why not for every non-paying industry?

Much the same arguments apply to lead. It is, however, a remarkable and disconcerting fact that if we except the continuance of the Joplin field into Oklahoma, the Bawdwin deposit in Burma is the only really large new deposit of lead that is known to have been found anywhere in the world in the past ten years. This shows how much nearer the end of the mines may be than we have thought.

Bromine is saved as a byproduct from salt wells and will be saved only if the price and demand justify. Arsenic is caught in the fumes at the great copper and precious metal smelters and practically must be saved to prevent its being a nuisance. Though some is now being made from arsenopyrite, no direct production is needed if the fumes are saved. Before the great increase in freight rates it could be marketed very cheaply. The duty asked, 5c., is probably more than a 100 per cent tariff on cost f.o.b. New York.

Our supplies of sulphur are comparatively large and cheaply produced from the domes of Louisiana and Texas. It is difficult to see how anyone can compete with them more than temporarily. If prices on both pyrite and sulphur are revised upward by high tariffs, the price of sulphuric acid, fertilizers and other materials must rise accordingly, or be kept from approaching pre-war levels.

MINERALS IN LARGE QUANTITY

The minerals in large quantity are mostly those generally referred to as non-metallic, by which we mean that the compounds are more useful than the contained metals are after isolation. They are mostly bulky materials and the supply approaches infinity so far as human industry is concerned. Thus the ocean is a huge salt bed in solution and an inexhaustible supply of magnesium ore.

In these bulky products, position, freight and labor, rather than foreign competition, may cut the largest figures, and unless carefully drawn laws are made one locality may be placed at the mercy of a particular company.

This may be illustrated by a story told some years ago by a gentleman connected with a cement company. The company owned cement plants near the boundary in both this country and Canada. When a former tariff law was being framed in this country, he went before the Ways and Means Committee and asked for a specific duty of \$1 a bbl. on cement to keep out the "pauper-made" cement of Canada and other countries, explaining that an earlier tariff of 20 per cent was equal to about \$1 a bbl. He did not explain that, at the earlier date, the price of cement was \$5 a bbl., but that at the time of his plea cement was being made profitably as low as 70c. a bbl. Then he went to Canada and petitioned for a tariff of 20 per cent against the American cement, as he wished to put up a mill in western Canada, where an extensive region was being supplied by a recently erected American plant. After both tariffs were granted, a new plant was built to supply the field in western Canada, and both an American and a Canadian community were compelled to pay tribute to the company.

Before the war anhydrous magnesium chloride used as a source of magnesium and as a component of oxy-chloride cements came from Germany, where it was made as a byproduct of potash refining. Probably it has not been very successfully made anywhere in this country, though the hydrous chloride is easily made.

Phosphorus is made in the electric furnace from lime phosphates. The other items are so familiar that little explanation is needed except as to coal.

M. R. Campbell estimates that at the present rate of use we have coal enough for 4,000 years, but the best steaming coal is being used rapidly and may not last more than fifty years, so that this might well be separated and put under Class C. Of the lignites and other poor coals the supply is huge, but on the other hand our uses are increasing at a rapid rate. As the United States is the largest exporter of coal, a tariff could have the effect only of raising the already high price in some poorly supplied locality like the Pacific Coast.

The fixing of a tariff on this group of minerals may well follow the same considerations as are applied to the fixing of tariffs on manufactured articles or farm products.

GENERAL CONSIDERATIONS

Some repetition in an effort to emphasize some of the points raised in this paper may be pardonable.

Of certain necessary minerals and metals we have practically none. Of certain other minerals, the bulky and common class, our supplies are very large, and of a few like salt, magnesium and lime, the supplies are, so far as human industry is concerned, unlimited. Between these two groups of minerals are two other groups. Of one we have a known quantity sufficient for our needs for a short time only and at highly artificial prices. Of the other we have a supply that is sufficient for our needs for some time to come. To all of the deposits of these two groups there is a definite end. Using them is precisely like drawing the water from a cistern, except that an ore deposit is filled only once, and when once mined, it is gone. There is no second crop. They are wasting assets.

Of the first group, that which we lack entirely, diamonds for gems are luxuries sold at absurdly extravagant prices, and no valid objection can be made to a duty of an amount comparable to the price. On the other substances, except borts and carbons, tariffs may be levied according to the theories of the party in power without directly affecting the mining industry of this country. To the last group tariffs may be applied much as to manufactures.

The minerals of the two middle groups, except bromine and arsenic, deserve entirely different consideration. Bromine and arsenic may also fairly be treated as manufactured products, for bromine will be saved from brines only if it pays, and arsenic can be supplied to fill all our needs as a byproduct from the smelters. We have the others in limited quantity. To place a tariff on them is to place a premium on depletion and to hasten the day when they too will be among the minerals of which we cannot supply our own needs. To bring that day more quickly than necessary is economic crime.

The civilization that we enjoy and that we are attempting to intensify is making more and more use of mineral products. To our grandfathers nickel was a curiosity; to our fathers aluminum was an unseen metal; tungsten, vanadium and chromium were heard of only among the abstruse things of chemistry. To us they are all necessities, and perhaps the Great War was won so soon because Germany lacked tungsten.

The mineral products are becoming more and more indispensable to us and depletion of deposits more and more of a menace. A hundred years ago iron furnaces were operated on chunks of iron ore picked up between Washington and Baltimore; now a single blast furnace will turn out as much pig iron in a day as one of those furnaces would in months, and it must have a large and assured ore supply to guarantee operation. When our great Lake Superior iron deposits were discovered they were heralded as inexhaustible—but our iron and steel industry has grown so that already we have had to commence beneficiation of the lean Lake Superior ores, and American firms are exploiting iron deposits in Cuba and Chile. It is probable that in 100 years the owners of the Brazilian iron fields will control the world's steel trade.

We have been the world's greatest copper producers, but our energetic mining firms have found it expedient to take over the great copper deposits of South America.

Besides these great investments by the most powerful of our mining interests, many smaller investments have been made in foreign mines—made at a time when our every endeavor has seemed to be to obtain foreign trade. These men have retained their American citizenship, and their ties with the United States are very real. Uncle Sam never forgets them when their income tax is due and they pay precisely the same rates as those of us who live at home where we have some advantage from the tax. These men have been, and are, the advance guard of American exports. They buy American machinery, foods and clothing; and in very many places they import American timbers for their mines and American lumber with which to build their mills. They are probably our best field agents for American exports. Do we believe in American exports, or is it mere cant?

Some of the American owned foreign mines are so close that the minerals are brought into the United States by aerial tramways; others are in the snowy heights of the Andes and in torrid India.

Probably the total American investment in foreign mines amounts to between \$600,000,000 and \$1,000,000,000, and if our metallurgical industry grows with our population it will mean greater and greater foreign investments. Are these then to be forgotten when we are passing tariff legislation?

Not only our own Americans but other miners in foreign countries are willing to sell us their cheap and rich ores. If we insist on making our own ores expensive by placing a protective tariff on foreign ores, then we place in the hands of our competitors the cheap ores of the world, and our manufactures must be increased in cost. The proposition that ores intended for incorporation in goods to be exported will be relieved of duty only half answers the question. Our own machinery and the manufactures of our own country must yet be made of the expensive ore, and the cost is passed on to the consumer, with the argument for each duty that it affects him little. Straws broke the camel's back.

But above all, the tariff puts a premium on the early depletion of our deposits. It will leave posterity only the caved mines that might have been an asset to them. Posterity will have to buy from the foreigner his deep mined ores and the United States will always work on expensive metallic products. The cynical question, "What has posterity done for us?" so glibly asked in reply to such an objection, may be answered by another and more honest question:

"Shall we rob our children?"

Imports of Carbonate of Potash Into the U. S.

There was 33,380,205 lb. of carbonate of potash, valued at \$1,218,851, imported into the United States during the calendar year 1920. The countries of origin were as follows, according to data compiled by the Statistical Division of the Bureau of Foreign and Domestic Commerce:

Countries	Lb.	Value	Countries	Lb.	Value
Austria.....	11,023	\$3,914	Switzerland.....	5,089,720	\$214,274
Belgium.....	227,736	3,702	England.....	346,735	35,716
Czechoslovakia..	170,854	26,695	Scotland.....	10,000	452
Denmark.....	22,386	5,148	Canada.....	61,529	4,414
France.....	15,139,936	136,410	China.....	26,000	4,109
Germany.....	7,891,821	445,095	Dutch East In-		
Netherlands.....	2,367,806	62,290	dies.....	34,442	9,493
Russia in Europe..	1,185,028	106,653	Hongkong.....	8,628	1,323
Spain.....	256,346	7,440	Japan.....	495,740	141,608
Sweden.....	34,481	10,115			
			Total.....	33,380,205	\$1,218,851

Largest Electrified Sugar Mill in Central America

It has been decided to electrify the new sugar mill of the Sula Sugar Co. at La Lima, Honduras, and plans have been drafted which will make it the largest electrified sugar mill in Central America. Power will be developed by a 1,000-kw. turbo-generator set with an auxiliary set of 200 kw. for lighting and general purposes. All the electrical equipment will be furnished by an American company and installation will be made by the same American company that is constructing the mill. The fuel to be used for running this system will be cane fodder and scraps, the supply of which is expected to be sufficient. Construction of the new mill is going forward rapidly. The boilers have been set in place and smokestacks and water towers erected. Most of the heavier machinery is also installed and the machine shop is nearly completed. Consul Albert H. Gerberich, Puerto Cortes, Honduras, reports that the first cane will be crushed in October.

Preventing Corrosion in Iron and Steel Under Water*

The Intensity of Corrosion Under Water Is Almost Proportional to the Amount of Oxygen in Solution—Mechanical and Chemical Means of De-aërating the Water, Thus Retarding the Rate of Corrosion

By F. N. SPELLER

Metallurgical Engineer, National Tube Co., Pittsburgh, Pa.

THE electrolytic theory of corrosion as formulated in 1903 by Dr. Whitney has led to the development of certain protective systems which are based on the removal of dissolved oxygen from water. Careful experiments in the research laboratories of the Massachusetts Institute of Technology and the National Tube Co. have demonstrated that the amount of corrosion found is almost directly proportional to the amount of oxygen in solution and varies directly as the temperature. The predominating influence of free oxygen in water was suspected before this as a result of the early study of pipe corrosion, for the most striking fact in practical pipe experience is that hot-water-heating systems invariably showed no corrosion to speak of after 35 or 40 years' use, whereas frequently hot-water-supply systems operating at the same average temperature with the same water lasted only six or eight years. That this was independent of whether the material was iron or steel was fully demonstrated by many service tests which were conducted for a period of over ten years, in which representative pipes of each class were installed alternately in hot water lines. A few of the more recent tests by independent observers are given in Table I for reference. It is believed to be unnecessary in view of this evidence to refer to any of our older investigations recorded elsewhere several years ago.¹ Suffice it to say that all the reliable data on this subject which we have seen up to the present indicate that the composition of the iron—i.e., the varying amount of carbon, phosphorus, manganese, sulphur, silicon, oxides, slag and copper usually found in wrought iron and soft steel—makes very little difference on the amount or character of corrosion under water. This refers particularly to the depth of corrosion commonly known as pitting.

INFLUENCE OF MILL SCALE ON PITTING

The location and depth of pitting seem to be mainly determined by variations of potential on the surface of the metal, principally due to the mill scale in irregular patches usually found on the surface of rolled iron or steel. Welded pipe and tubes having a particularly heavy and tightly adhering scale are on this account susceptible to pitting. It has been found by experimenting that the useful life of the tube as measured by the time to perforate is materially increased by removal of all mill scale and rust. Several years ago, after considerable study of the influence of mill scale on corrosion of iron in service, the National Tube Co. gave me the opportunity to make an attempt to remove this scale from pipe. A butt-weld pipe mill was provided with

special machinery for this purpose. The pipe was made about 10 per cent larger than standard. After welding it was cooled to about 1,700 deg. F. and passed at this temperature through a train of circular reducing rolls by which the section was reduced to standard size, and the pipe elongated, thus breaking loose all scale. The usual straightening operations followed during which a light loosely adhering scale formed which has little influence on corrosion and is easily removed if desired by pickling.

In the absence of oxygen such electro-negative materials as mill scale, oxides of iron, copper or brass have much less influence in accelerating corrosion.

It is necessary to establish these points before entering on a practical consideration of the subject of protection of steel, which in the case of closed systems can evidently be accomplished in most cases by elimination of dissolved oxygen from the water.

In practice oxygen removal has been accomplished economically in two ways, namely: By de-aërating the water mechanically and by fixing the free oxygen by chemical combination.

MECHANICAL DE-AËRATING OF WATER

The mechanical de-aërating of water is accomplished by passing the water over baffles or spraying into a high vacuum chamber at normal temperature or by increasing the temperature and controlling the pressure and temperature so that more or less complete removal of all the gases is obtained.

One system which has been proposed involves heating the water above the boiling point corresponding to

TABLE I. WEIGHED TEST PIECES IN HOT WATER LINES

Comparative corrosive action of de-aerated and of untreated water at Irene Kaufmann Settlement, Pittsburgh, Pa., on (1) zinc plates, (2) brass plates, (3) steel and brass plates coupled together, and (4) steel and copper plates coupled together. Test finished Jan. 14, 1919.

Test	Piece No.	Original Weight, Grams	Final Weight, Grams	Loss in Weight, Grams	Loss, Grams per Sq. In.
(1) Zinc plates 2x6x $\frac{1}{8}$ in. Area—28 sq. in. Time—12 mos., 52 days. Avg. temp. about 160° F.	DD-4	348.15	314.70	33.45	1.194*
	DD-5	351.62	320.90	30.72	1.097*
	DD-6	350.82	316.35	34.47	1.231*
	DD-1	Lost			
	DD-2	352.20	348.10	4.10	0.146†
	DD-3	351.00	346.50	4.50	0.161†
(2) Brass plates 2x6x $\frac{1}{8}$ in. Area—25 sq. in. Time—12 mos., 52 days. Avg. temp. about 160° F.	BB-1	108.87	108.50	0.37	0.011*
	BB-2	105.50	103.65	1.85	0.074*
	BB-3	107.00	105.95	1.05	0.042*
	BB-4	107.08	107.00	0.08	0.0032†
	BB-5	103.97	103.90	0.07	0.0028†
	BB-6	108.15	108.09	0.06	0.0024†
(3) Steel and brass plates (1x4x $\frac{1}{8}$ in.) coupled together with brass rivets at one edge. Area 14 sq. in. Time—12 mos., 10 days. Avg. temp. about 160° F.	Brass-C-3	28.893	28.391	0.502	0.036*
	Steel-C-3‡	16.008	0.00	16.008	total loss*
	Brass-C-4	29.474	29.463	0.011	0.0008†
	Steel-C-4	15.809	13.268	2.541	0.1815†
(4) Steel and copper plates (1x4x $\frac{1}{8}$ in.) coupled together with copper rivets at one edge. Area 14 sq. in. Time—12 mos., 10 days. Avg. temp. about 160° F.	Copper-B-3	16.535	16.368	0.167	0.0119*
	Steel-B-3‡	16.128	0.00	16.128	total loss*
	Copper-B-4	16.444	16.416	0.028	0.002†
	Steel-B-4	16.623	13.255	3.368	0.2405†

* In untreated water line. † In de-aerated water line. ‡ Steel pieces C-3 and B-3 were entirely corroded away.

*Paper presented at the spring meeting of the American Electrochemical Society at Atlantic City, N. J., April 21, 1921.

†Comparative service obtained with wrought iron and soft steel pipes as water lines in the United States. International Association for Testing Materials, New York, 1912.

the pressure and spraying into a chamber at lower pressure. The air and aqueous vapor are drawn through a condenser where the vapor is condensed with a simultaneous transfer of heat to the incoming cold water. Almost perfect removal of gases is said to be accomplished in this way and there is no reason why nearly perfect removal cannot be thus obtained with a properly designed plant, but the condenser and other apparatus required makes such a plant quite costly and subject to severe deterioration.

For practical protection of water pipe from internal corrosion at 180 deg. F. (80 deg. C.) it is not necessary to have the oxygen lower than 0.4 c.c. per liter (cold water carries from 5 to 10 c.c. per liter, depending on the season of the year and temperature). For the protection of steam boilers, superheaters and economizers operating at a much higher temperature, the oxygen should be below 0.2 c.c. per liter or an appreciable amount of corrosion will occur. This may be accomplished by means of de-aerators now on the market, which are simple in construction and operate without heating the water to the boiling point. (Fig. 1.) The design of the apparatus used should be adapted to the particular conditions in each case. Several of these are in use doing good work in the protection of iron and steel hot-water piping systems and boilers. A large system has recently been installed to de-aerate 5,000,000

to 20 per cent of that previously experienced, this being a very corrosive water.

FIXING FREE OXYGEN BY CHEMICAL COMBINATION

The fixing of the free oxygen in the water by chemical combination has been carried out in practice in the case of hot-water systems by passing the heated water through a storage tank carrying a mass of expanded sheet iron giving about 60 to 70 sq.ft. of surface per cu.ft. of space (200 to 230 sq.m. of surface per cu.m. of space). In half an hour or so at 170 deg. F. (77 deg. C.) the oxygen may be reduced in this way to 0.3 c.c. per liter. If the water carries free CO_2 and bicarbonates, as is usually the case, the free CO_2 contents are often a little higher after this treatment, notwithstanding which practically no corrosion is found. My first experiments with the use of scrap iron in 1907 were made with steel turnings, which after a time clogged up tightly into an impermeable mass. This difficulty was overcome by the use of expanded steel sheets suitably formed so that they would not pack tight. The first plant of considerable size based on this principle was designed and built by the author in Pittsburgh in 1915, and has now been in successful operation for over five years; the essential features involved are indicated in Fig. 2. For domestic use the water after this treatment should usually be filtered.

COMBINATION OF MECHANICAL AND CHEMICAL DE-AERATION

This method of "de-activation" (the term suggested to designate this process) may be used to supplement mechanical de-aeration as described above, which combination seems to be the most economical means for oxygen removal from hot water on a large scale under average conditions. For example, take a power plant equipped with open-feed water heaters operating at 180 deg. F. (80 deg. C.); it will be found possible by means of the heaters alone to reduce the free oxygen in the feed water from 8 c.c. to 2 c.c. per liter. If the water space of the heater is filled with thin steel lathing or the water, preferably in some cases under reduced pressure, be made to flow through another tank containing steel scrap in this form, the residual oxygen will be fixed in a few minutes. Water so treated is practically inactive toward iron, and may be used in boilers or steel economizers without fear of corrosion so far as the water is concerned.

Other metals in scrap form may be used for oxygen removal, such as zinc, but iron is the most economical, not only because of its low first cost but for the reason that the ferrous hydrate formed removes an equivalent of oxygen in addition to oxygen taken up by the hydrogen. Furthermore it has been proved to be true, as would be inferred from the above, that the corrosion of zinc, brass and other metals is greatly retarded if not entirely stopped by the removal of oxygen from the water which comes into contact with these metals.

Brass and copper piping are seriously attacked by heated water under pressure. For example, we find that the water which is heated for our laboratory in a copper coil heater of the usual type loses nearly one-half of its free oxygen in passing through this heater, and brass pipes after ten or twelve years are frequently found to have lost nearly all their zinc contents. The same has been observed with alloy condenser tubes, so that there is apparently an important field for the application of these principles of protection to brass and copper piping systems.

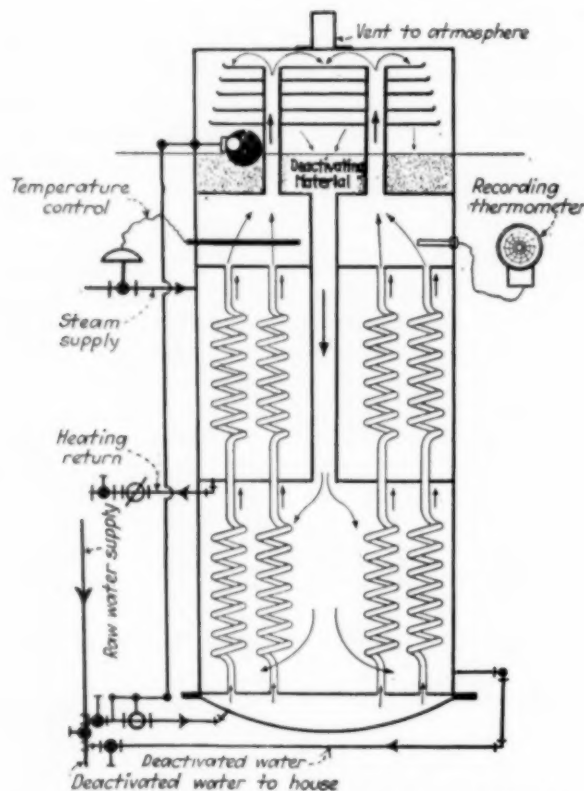


FIG. 1. MECHANICAL WATER DE-AERATOR

In operation the cold water enters the aerator at the bottom and flows upward through the coils, taking up some heat from the down-flowing water. The temperature of the water is raised to about 205 deg. F. (96 deg. C.) as it passes through the middle steam-heated compartment. From this the water rises and flows over baffles, where the air is nearly all separated, the residual oxygen being removed by some suitable de-activating material before the water passes downward to the outlet, its temperature being reduced to about 150 deg. F. (66 deg. C.) in passing through the lower heat exchanger.

gal. (20,000 cu.m.) of cold water per day for the protection of the 30-in. (75-cm.) steel main from the Darling ranges to Coolgardie mining district, Western Australia, which is reported to have reduced the corrosion

TABLE II. SUMMARY OF RESULTS OF INVESTIGATIONS OF THE CORROSION OF WROUGHT IRON AND STEEL PIPE IN HOT WATER SUPPLY SERVICE

Date	Where Test Was Made	Length of Time Pipe Lines Were Installed	Authority and References	Number of Cases on Record	Average of Deepest Pits, Inches		Conclusions
					Wrought Iron	Steel	
1919	Irene Kaufmann Settlement, Pittsburgh, Pa.	2 yrs., 7 days.	Jas. O. Handy, Technical Director, Pittsburgh Testing Laboratory. Report made to Resident Director, Tellico, H. & V. Engrs.; p. 276, Mar., 1920. A. S. H. & V. Engrs.	Fifteen lengths of steel, 15 lengths of wrought iron arranged alternately.	0.1144	0.1095	"These figures show that no marked distinction is possible between the rate of corrosion of the steel and the iron pipe."
1919	Harvard University, Cambridge, Mass.	3 yrs.	Melville C. Whipple, Inst. in San Chem., Harvard University. Jnl. New England Water Wks. Assn., p. 42, Mar., 1920.	Two sections each of scale-free (steel); steel and copper steel and wrought iron pipe.	0.073	Scale Free 0.045 Copper Steel 0.068 Galvanized 0.078	"Judging from the depths of pitting and the general appearance of the inside of the pipe, it was evident that, so far as the conditions of this particular experiment with the Cambridge hot water service were concerned, scale-free pipe had suffered less real damage than any of the others after three years exposure."
1919	Irene Kaufmann Settlement (2d Test), Pittsburgh, Pa.	1 yr., 2 mos.	Jas. O. Handy, Technical Director, Pittsburgh Testing Laboratory. Report by Pittsburgh Testing Laboratory, April 10, 1918, p. 217, 1918 Trans. A. S. H. & V. Engrs.	Six sections each of steel and wrought iron pipe.	0.131	0.122	"This test and other similar tests have shown beyond question that in the Pittsburgh district wrought iron and steel pipes in hot water lines are rapidly corroded by pitting and that the laminated or fibrous structure of wrought iron produced by the included layers of slag, does not give any added durability to wrought iron, as compared with steel pipe."
1918	Brown University, Providence, R. I.	11 mos.	Wm. F. Kenerson, Professor of Mechanical Engineering, Brown University. Report made June 7, 1918, Bulletin 2—"Corrosion of Hot Water Piping," National Tube Co.	Two sections each of black and copper steel and wrought iron; one section each of galvanized and copper steel, galvanized.	0.0674	Black Steel 0.0344 Copper Steel 0.0639 Galvanized 0.0547 Copper Steel Gal. 0.0936	"There is evidently no marked superiority of either the wrought iron or steel for the test conditions described. . . . The wrought iron failed first by developing the deepest pits. The steel developed a greater number of shallower ones."
1917	This test was conducted in four different places as follows: (A) West 41st St. Bath, New York. (B) East 76th St. Bath, New York. (C) East 109th St. Bath, New York. (D) Cherry and Oliver Sts. Bath, New York.	2 yrs., 9 1/2 mos. 2 yrs., 5 mos. 2 yrs., 6 mos. 2 yrs., 6 mos.	James S. Macgregor, Instructor in Civil Engineering, Columbia University. Report made Jan.-March, 1917, Bulletin 2—"Corrosion of Hot Water Piping," National Tube Co.	(A) 3 sections each of wrought iron and steel pipe. (B) 4 sections of steel and two of wrought iron pipe. (C) Same as test B. (D) One section each of steel and copper steel.	(A) 0.057 (B) 0.075 (C) 0.035	0.052 0.070 0.035 (D) Steel 0.021 Copper Steel 0.022	Taking the total averages of steel (which includes scale-free and copper steel, as well as ordinary black), pipe as against those for iron in the four tests we find the latter to have pitted deeper by 0.025 in., which indicates in favor of steel pipe in these particular tests.
1916	Irene Kaufmann Settlement, Pittsburgh, Pa.	11 mos.	Jas. O. Handy, Technical Director, Pittsburgh Testing Laboratory. Report made December 6, 1916, p. 125, 1917 Trans. of A. S. H. & V. Engrs.	Two sections of steel, one of galvanized steel and one of wrought iron pipe protected by deoxidizer; 2 sections each of steel and wrought iron pipe not so protected.	Protected by Deoxidizer 0.045 Unprotected by Deoxidizer 0.121	(Galvanized) 0.040 (Black) 0.016 0.123	This test had as its chief aim a study of the protection of pipe by use of a deoxidizer, and the author does not draw direct conclusions on the comparative corrosion of the iron and the steel pipe. The figures on depth of pitting, however, stand in favor of steel pipe.
1916	Irene Kaufmann Settlement, Pittsburgh, Pa.	10 mos.	Jas. O. Handy, Technical Director, Pittsburgh Testing Laboratory. Report made October 31, 1916, p. 125, 1917 Trans. of A. S. H. & V. Engrs.	Seven sections of steel and 4 of wrought iron pipe.	0.116	0.110	The author states that a certain sample of wrought iron showed the most general corrosion, while a steel section showed the greatest number of separate pits. No direct reference to comparative corrosion is made.

In connection with our tests in Pittsburgh we placed some zinc, brass, and steel-brass and steel-copper plates in contact in raw and de-activated hot-water service for one year with the losses in weight shown in Table I.

The accelerating effect of copper and brass in contact with steel under these conditions has been greatly reduced by the lack of a depolarizer, as would be expected, and it will be noted that the loss in weight of the steel when in riveted contact with copper and brass is very little more than that suffered by the insulated zinc plates in de-activated water under the same conditions. In this experiment the test pieces were placed in two horizontal steel water lines, one carrying raw water

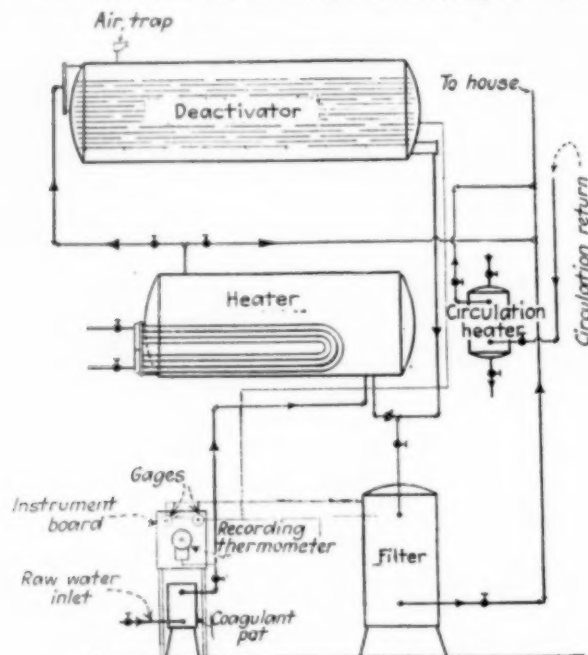


FIG. 2. CHEMICAL WATER DE-AERATOR

In this system the oxygen is removed by combination with scrap steel sheets in the upper tank (the de-activator). The heater circulating pipes and filter are shown.

with about 6 c.c. per liter of oxygen and the other water with an average free oxygen content of about 0.3 c.c. per liter.

RETARDING THE RATE OF CORROSION

The rate of corrosion may be retarded by increasing the proportion of hydroxyl ions with relation to the hydrogen ions present in the water. In practice in the case of boiler water this can be carried out by the use of 5 to 10 grains per gallon of hydroxide alkalinity, but with domestic water it is possible to use only a comparatively small amount of alkali and the protection afforded is proportionately lessened. Great Lakes water with about 8 grains per gallon of calcium carbonate is very much less corrosive than New York city water with 1 or 2 grains per gallon of carbonates, although each have about the same amount of oxygen.

There are cases where natural waters used for cooling purposes in condensers or transformers may have their corrosive activity reduced with economy 50 per cent or more by passing the water through a bed of crushed limestone, but this treatment is not nearly so effective as partial de-aeration and may cause an insulating scale to form if this treatment is carried too far.

The more important research on the subject of relative corrosion of piping in hot water feed service that has been accomplished within the last five years is summarized very briefly in Table II.

Alsatian Potash Production in 1920

Commercial Attaché Huntington, at Paris, has transmitted comparative statistics on the Alsatian potash situation.

The total production of the Alsatian mines in 1913 was 350,341 tons, corresponding to 56,000 tons of pure potash; in 1919 the production was 464,607 tons, corresponding to 92,006 tons of pure potash; and in 1920 the total reached 1,061,191 tons, corresponding to 199,230 tons of pure potash.

The following shows the amount of the 1919 production of the grades named compared with the production of 1920:

Grades	1919 Tons	1920 Tons
Sylvinite, 12 to 16 per cent.....	262,779	664,019
Rich sylvanite, 20 to 22 per cent.....	163,714	335,820
Chloride of potassium, 50 to 60 per cent.....	38,114	61,352
Total.....	464,607	1,061,191

Shipments during 1919 and 1920, expressed in terms of pure potash, were in amount as follows:

Grades	To France		To United States		To Other Countries	
	1919 Tons	1920 Tons	1919 Tons	1920 Tons	1919 Tons	1920 Tons
Sylvanite, 12 to 16 per cent.....	20,820	43,994	11,022	27,355	6,303	25,557
Rich sylvanite, 20 to 22 per cent.....	16,260	31,420	8,276	19,720	9,096	17,679
Chloride of potassium, 50 to 60 per cent.....	9,973	11,164	3,849	8,892	6,407	13,394
Total.....	47,053	86,578	23,147	55,967	21,806	56,630

Since March, 1921, the concentration plants of the Alsatian potash mines have been manufacturing rich sylvinite of 30 per cent K_2O content and sylvinite of 40 per cent K_2O content.

Niagara Hydro-Electric Canal Nearing Completion

The hydro-electric canal is and has been making rapid progress toward completion. This great public work has been especially favored by the weather, which made it possible for the work to go on unimpeded during the past winter.

Of 13,500,000 cu.yd. of earth excavation, 12,500,000 cu.yd. has already been removed; while of the 4,000,000 cu.yd. of stone excavation, 2,500,000 has been taken out. This speed in the removal of earth and stone has been accomplished by shovels which excavate 8,500 cu.yd. of earth or 3,000 cu.yd. of stone in twenty hours with two shifts of men. These shovels handle 8 cu.yd. of earth or 6 cu.yd. of stone at a time. The deepest cut in the canal is 135 ft.

At the present rate of progress the earth excavation will be finished by July next and the stone excavation by August. The excavation of earth and stone are now ahead of schedule.

There is 280,000 cu.yd. of concrete work in the walls of the canal, while in the power house, screen house, intake and control works there is 145,000 cu.yd., making a total of 425,000 cu.yd. of concrete work. Three turbines of 52,500 hp. have already been installed; generator 1 is well on the way to completion, and generator 2 is set in place, but not yet wound. By Jan. 1, 1922, there will be in operation 100,000 hp.

There are now, and have been during the past winter, 7,200 men working on this job. To house the workmen it has been necessary for the Hydro-Electric Canal Commission to construct many buildings, as it is has been impossible to get adequate housing accommodations in the City of Niagara Falls, Ont.

A New Type of Benzene Still in European Operation

Descriptive Details of the Tubular Type Bamag Benzene Still—Tee Head Joints—Vapor and Condensate Countercurrent Flow Positive—Central Control
—Notes on Corrosion

By A. THAU

Superintendent of the Oxelösund's Iron Works, Sweden

DURING the war a new type of benzene still was brought out by the Bamag Co. of Cologne which was the result of many forerunners and while not free of faults, it can at least claim perfection in its line. The still consists of a number of horizontally arranged cylinder sections joined by flanged branches. A short description will be given and in order to make the somewhat complicated looking design readily comprehensible the rectifying sections in which no heating arrangements are provided will be described first.

RECTIFYING SECTIONS

Fig. 1 shows such a still section in vertical section, Fig. 2 the left head in line AB of Fig. 1 with its connections through which the vapors enter from below, while the condensed oil runs down from above through the upper branch. Fig. 3 shows a vertical section of the apparatus in line CD of Fig. 1, and Fig. 4 a section through the opposite head of the still section in line EF of Fig. 1 with the vapor outlet through the upper branch, while the condensate leaves through the lower branch.

The section consists mainly of a cylindrical, horizontally suspended tubular body *a* of 200 mm. internal diameter with flanges *b* on both ends. The tee heads enable a number of sections to be assembled into one still. The tubular body *a* in Fig. 1 is partly closed by

a cast-in partition *c*. This partition is grooved inside, projects into the head *d* and holds the wrought iron distributing pipe *f*, which is expanded into the socket *e* and passes through the entire length of the section, projecting a little into the opposite head *g*. The closed end distributing pipe *f* is bored with two rows of holes *h*. The construction of the head *d* can be seen upon inspection of Figs. 1 and 2. The condensate flows through the branch from above and is diverted upon reaching the cast partition *i* to both sides and conducted into the passage *k* under the socket *e*. In the lower half of the partition *c* a radial opening *l* is left as shown in Fig. 1 and conducts the condensate from below, thereby filling the whole section and sealing the openings of the vapor distributing pipe *f*. On the open end of the body *a*, opposite to the liquor entrance side, a vertical support *m* is fixed which holds the distributing pipe *f* rigidly and positively level. In the lower half of the head *g* the dam *n* is cast and cut to the height of the upper edges of the holes *h* in the vapor distributor *f*. In the opposite head *d* the dam *o* is higher than *h*. In the head *d* the partition *i* forms a closed annular space (Fig. 2) which is in direct connection with the distributor *f*, being open on this end, while the annular channel continues downward into the connecting branch *p*.

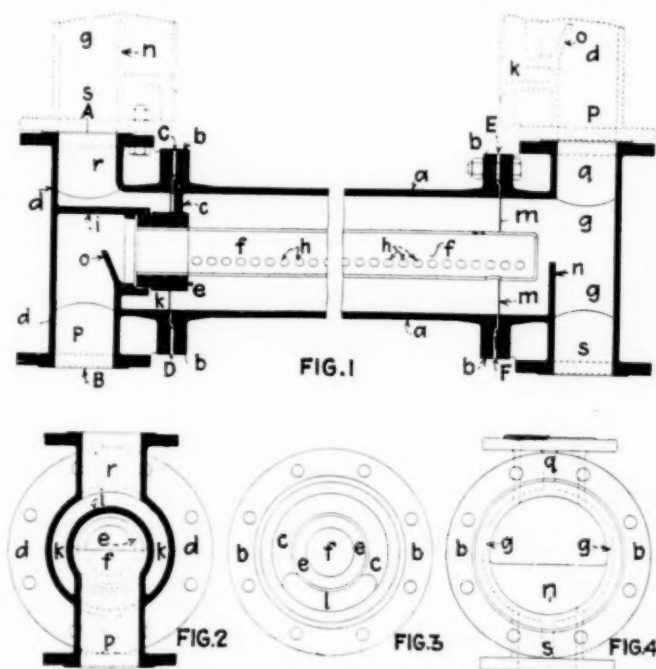
ROUTE OF VAPOR AND CONDENSATE

The vapors entering from the still section through the branch *p* are conducted through the channel formed by the partition *i* inside the end piece *d* and reach the distributor *f*. Equally distributed by the holes *h*, the vapor is forced through the liquid seal and enters the end piece *g*, from which it escapes through the connecting branch *q* and enters the next higher section, in which it repeats the operation. As indicated by the dotted lines in Fig. 1, representing joining sections, they are put together in the returning direction, so that piece *g* always goes on head *d*.

The condensed benzene entering the head *d* from above through the branch *r* circulates through the section as described before and increasing in volume by the addition of condensate, runs over the upper edge of the partition *n* and leaves the end piece *g* through the lower connecting branch *s*. The liquid enters the next section below through a head *d*.

By such means a positive and segregated countercurrent flow of liquid and vapor is obtained through the whole still. They pass separately through the connecting heads and are in contact only when inside the sections. The cylindrical bodies of these sections between the flanges *b* are thickly insulated to prevent too rapid condensation.

The distilling sections in which heat is introduced

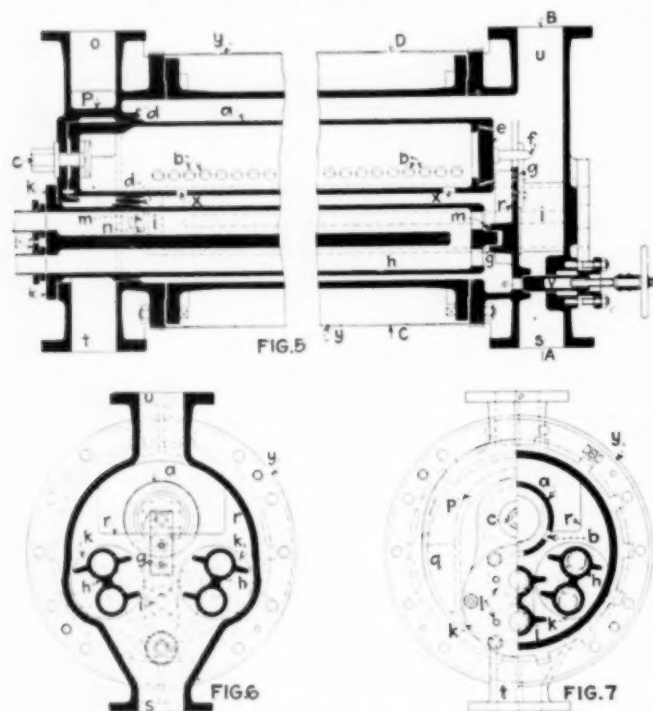


FIGS. 1 TO 4

Fig. 1—Longitudinal section of rectification section. Fig. 2—Vertical section through Fig. 1 at AB. Fig. 3—Vertical section through Fig. 1 at CD. Fig. 4—Vertical section through Fig. 1 at EF.

by indirect steam resemble those just described very much and the action set up in them is decidedly the same. The difference is in the use of three heating elements in each section, which results in a greater internal diameter of the cylindrical bodies. Fig. 5 shows a longitudinal section through a still section, Fig. 6 a cross-section through the right head of Fig. 5 in line *AB* and Fig. 7 shows in the left half an outside view of the left head of Fig. 5 and to the right a cross-section through this head in line *CD* of Fig. 5.

In these sections the vapor-distributing pipe *a* is of cast iron and has two rows of equally spaced 1-in. holes.



FIGS. 5 TO 7
Fig. 5—Longitudinal section of distilling section. Fig. 6—Vertical section through Fig. 5 at *AB*. Fig. 7—Vertical section through Fig. 5 at *CD*.

The distributing pipe *a* is fastened at the entrance end of the vapors by the bolt *c* and supported in the socket *d* by means of asbestos packing. At the opposite end the distributor *a* is closed by a cast-iron plug *e* calked in with lead packing. The plug *e* holds a bolt *f* projecting through the hole *g* giving support to the distributor *a* and holding it level. Below the distributor *a* three heating elements are arranged in the distilling sections. The two heating elements *h* introduced from the left-hand side in Fig. 5 occupy the space below the pipe *a*, while the third, *i*, being introduced from the other end, is located immediately under the distributor *a* in the section between the other heating elements. These elements consist of tubular castings strengthened by side ribs and the steam passage through the elements is shaped like a U-tube. As will be seen from Figs. 6 and 7, the elements *h* on both sides are provided with three ribs, and *i* with four. The heating elements have a circular flange *k* which is drawn tight by bolts. The flanges are machined on both sides. The connections are so arranged that the upper openings of each element are connected to the high-pressure steam supply, the lower ones to a common pipe leading to a steam trap. The ends of the heating elements opposite the flange lids *k* are provided with a flat nose piece *m* reaching into a fork *n* cast into the branch lids of the sections. The heating elements are supported by these on both

ends. The nose piece *m* is somewhat shorter than the fork *n*, allowing for expansion of the elements.

OIL CIRCUIT

The oil entering from above passes through the branch *o* exactly as shown in the rectifying sections without heaters (Figs. 1 and 2) and is diverted by the partition *p* to both sides and enters the section through the two openings *q*, one of which is indicated on the left side of Fig. 7. The oil passes through the section, which is filled so that the holes *b* of the vapor distributor *a* are completely immersed in accordance with the level of the dam *r*. The surplus oil runs over the top edge of the dam on the heating element *i* (as far as this crosses the passage in the branch lid) and leaves the section through the passage in the head *s* to the next section. The vapors enter from below through *t*, pass through the annular space formed under the partition *p*, which is in direct connection with the open end of the vapor distributor *a*. They are then bubbled through the hot oil covering the ports *b*. The vapors pass upward through *u* to the next section, through which they are conducted in the same fashion. To obtain the zigzag passage of oil and vapor through the assembled units, it is necessary to connect the adjoining sections in opposite directions to Fig. 5—that is to say, if the letters marking the four connecting branches in Fig. 5 are applied to all the sections of which a still is composed, then the following combinations are observed: *ut*, *os*, *tu*, and *so*.

To drain these sections in case of repairs the head through which the heating element *i* is introduced is provided with the drain valve *v*. A hole *w* is drilled immediately above the bottom of the dam, which is closed by the valve. By opening it the section is drained completely, and the oil runs out through the opening *w*. The holes *x* are drilled through to drain the distributor dry when emptying the section. The cylindrical part of the sections is insulated and covered by sheet iron, giving the still a pleasing appearance.

THE ASSEMBLED STILL

The arrangement of a benzene plant in which continuous distillation of the crude products is effected in three such stills is shown in Fig. 8 in front view, while in Figs. 9 and 10 the stills are shown in side view, Fig. 9 in line *AB* and Fig. 10 in line *CD* of Fig. 8.

A strong concrete foundation supports two vertical frames *a* of steel construction. They are provided with cross beams *b* by which the weight of the stills is partly taken up by means of suspension bolts. The diagonally strengthened frames *a*, which are somewhat higher than the stills, hold the preheaters, dephlegmators and a platform with stairs.

A light-oil still *c* of normal capacity consists of seven cylinder sections each of about 2,700 mm. length and 600 mm. outer diameter. The sections are flanged together at the heads. The three heating elements of each section are supplied with high-pressure steam from the two common pipes *e*, while the two common pipes *f*, being connected to a steam trap *g*, drain the condensed water. The third steam pipe *h* running parallel to *e* and *f* conducts the steam to the heating elements of the oil preheater *i* on top of the platform. The enriched wash oil, which arrives somewhat preheated, having passed through heat exchangers in which it has taken up part of the heat of the light-oil vapors and of the spent oil

leaving the still, enters the preheater *i* through the pipe *j* and leaves it through the pipe *k* to enter the still *c*. It is admitted in the top section on the front, circulates through it toward the back, runs into the next lower section, through which it passes in the opposite direction, and so forth through the whole still, leaving the bottom section through a branch under the back side provided with a siphon.

DESCRIPTION OF OPERATION

The light-oil vapors leave the section through the head on the back side and enter the next section, which they leave through the head on the front side, and so forth through the whole still. From the head on the back side of the top section the vapors are conducted through the pipe *l* into the dephlegmator *m* and leaving the latter on the top are brought to a condenser. The pipe *l* is connected with the top of the preheater *i* by means of a pipe bent to so high a pitch that no oil can pass that way and only the vapors which are given off in the preheater are conducted direct into the dephlegmator.

The light oil produced in the still *c* is collected in a receiver and pumped to a tank sufficiently high to supply the preheater *n* by gravity. The preheated light oil is conducted through the pipe *o* into the top section

the second from back to front and through the third and last again from front to back, where the rest arrives free from benzene. It passes now through a siphon pipe *s* and enters the upper of the two sections of the naphtha still *q*. The residue leaving the lower section of the still *q* consists of wash oil holding naphthalene in solution and is conducted through a steam-

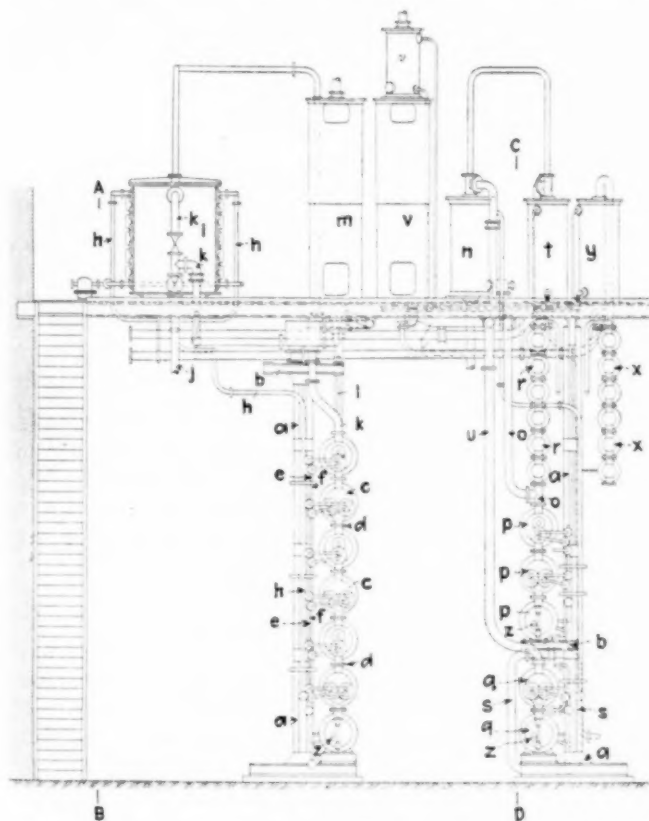
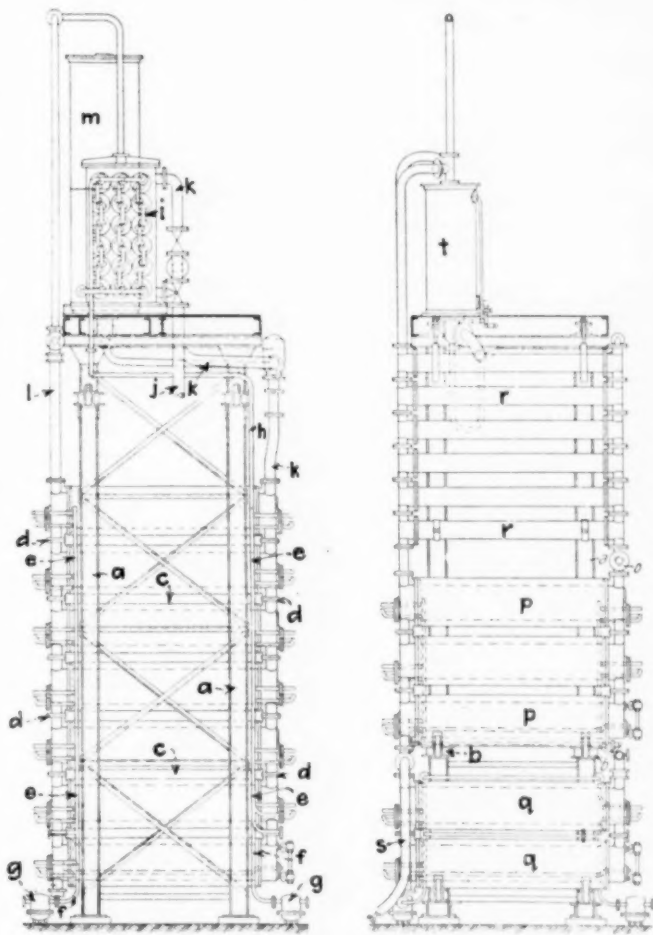


FIG. 8. FRONT VIEW OF ASSEMBLED STILL

of the still *p*, which, consisting of three distilling and six rectifying sections *r*, drives off the crude 90 per cent benzene. The still *q* is immediately under the still *p* and consists of two sections in which the products with a higher boiling point than benzene are driven off in one single fraction called crude naphtha.

The individual sections in the three stills *c*, *p* and *q* are of identical design. The preheated light oil fed into the still *p* through the pipe *o* circulates through the upper distilling section from front to back, through



FIGS. 9 AND 10.

Fig. 9. (left)—Side view showing preheater. Fig. 10 (right)—Side view showing naphtha still and dephlegmator.

heated pipe siphon to crystallizing pans, where the naphthalene solidifies, while the wash oil can be decanted off and brought back into the wash oil circuit.

The benzene vapors leaving the upper distilling section of the still *p* enter the rectifying sections *r* on top, which are in immediate connection with the still *p*. The surplus benzene condensed in the section *r* flows from the lowest section into a T-piece built into the light-oil feed pipe *o*, so that light oil and condensed benzene enter the still *p* together. The vapors leaving the upper section *r* are conducted through the water dephlegmator *t* of usual design with vertical water-cooled tubes. The vapors enter the dephlegmator from above and a pipe bent to a U is connected between the vapor pipe and the light-oil preheater *n* to conduct the vapors developed in the preheater direct into the dephlegmator *t*. Under the bottom of the dephlegmator a catch box is provided which conducts the condensed benzene from the dephlegmator through a siphon pipe back into the upper section of the rectifying still *r*. The vapors leaving the dephlegmator *t* are brought to a condenser of usual design.

The vapors driven off in the naphtha still *q* are conducted through the pipe *u* into the dephlegmator *v*, into

which they are admitted through a branch connection in the bottom. Leaving at the top, the vapors enter the small water dephlegmator *w* arranged immediately above the former. The vapors leaving the latter through a branch in the lid are conducted to a condenser of usual design. The naphtha condensed in the dephlegmators *w* and *v* runs to the bottom of the latter and collects in a catch box which is connected by means of a pipe to the siphon pipe *s* and thus enters again the section *q* of the naphtha still.

It will be quite clear now that the stills *q* and *p*, although arranged in one vertical line, are two independent units, the still *q* receiving the residue from the still *p* by means of an interconnected siphon *s*. Continuous benzene distilling is obtained in one process up to the point where the products must be washed. Two fractions are continuously produced—viz., 90 per cent crude benzene and crude naphtha, of which the latter must be separated in the desired fractions during the final distillation after washing.

NAPHTHA STILL

The lowest section of the stills *c*, *p*, and *q* differs from those described in Figs. 5 and 6 in that no vapor-distributing pipe is provided. This is not required, as no vapors enter the bottom sections in which the last traces of benzene are driven out. There are also only two heating elements in these sections and in place of the middle one a perforated steam pipe is introduced into the section resting on its bottom over the whole length. Through this a small amount of direct steam is admitted to the still—just enough to start and accelerate distillation. The three bottom sections *c*, *p* and *q* are also provided with glass gages to observe the liquor level inside, as indicated in the side views, Figs. 9 and 10.

The rectifying still *x* suspended from the platform and the water dephlegmator *y* on top shown to the extreme right in Fig. 8 form a quite independent unit from the apparatus so far described. They are of identical dimensions and construction as the unit *r* and *t* and are connected to the intermittently working finishing still for the treatment of the washed products. This still is of the usual design and thus not included in the figures.

The large dephlegmator *m* of the light-oil still *c* and the one *v* of the naphtha still *q* are hollow cylinders filled with wrought-iron cylindrical rings.

CENTRAL CONTROL BOARD

To control these stills the bottom section is provided with a gage glass to show the liquid level. The steam valves and pressure gages for each still are united on a control board, of which the one serving the crude benzene and the naphtha still at the same time is shown in front and side views in Fig. 4. The gage board is placed and fixed in front of the still and consists of lacquered sheet iron mounted on an iron frame and bent over to a right angle on both sides. Behind this plate the steam pipe entering with a main valve *a* is divided into several branches. By means of a separate branch with valve *b* steam is admitted to the heating elements of the benzene still. The pressure thereby applied to the elements is indicated by the high-pressure steam gage *c*. Through the valve *d* direct steam is introduced into the bottom section of the benzene still, the pressure thereby created in the section being indicated on the low-pressure gage *e*. The steam to the heating elements

of the naphtha still is admitted through the valve *f*, the pressure indicated by the high-pressure gage *g*. Direct steam is introduced into the lowest section of the naphtha still by means of the valve *h* and the pressure created therein is indicated by the low-pressure gage *i*. The valve *k* admits the steam to the light-oil preheater and its steam pressure is shown on the high-pressure gage *l*.

As indicated in Fig. 11, near every valve and gage an enameled plate is fixed labeling its purpose. The writer suggests in order to enlarge these very useful control boards that the thermometer dials belonging to the particular apparatus be installed on the same

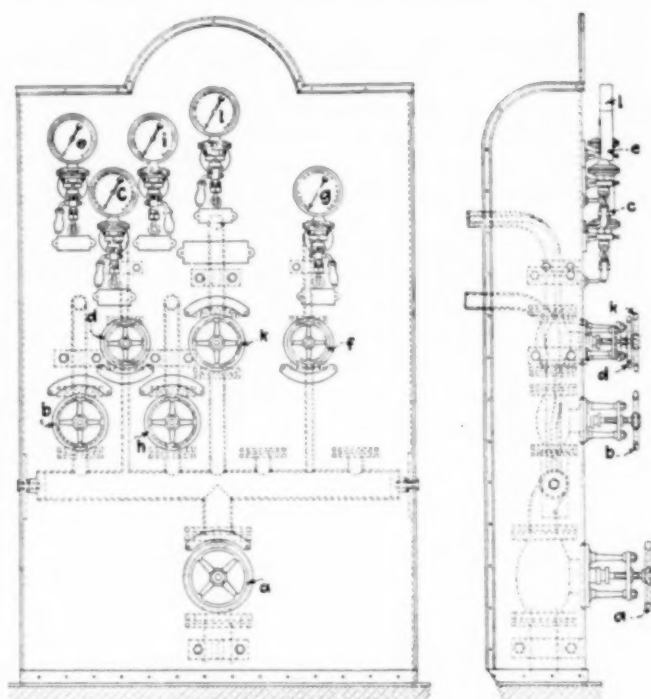


FIG. 11. CONTROL BOARD

board, which by using mercury steel tube thermometers with flexible connections between dial and mercury bulb does not present any difficulties. The control board should be provided with a thermometer showing the temperature of the steam, which, in connection with light-oil stills, is of great importance to keep the spent oil free of water on leaving the still.

The advantage of these latest designs of benzene stills is in the high efficiency reached. They have been working over a year, have not given cause for complaints and their steam consumption is relatively low. The distilling effect is mainly obtained by large indirectly heated surfaces over which the liquid is forced to travel almost continuously on its way through the stills. The amount of direct steam used is comparatively very small and in the case of light-oil stills the spent oil is kept free from water without the least difficulty.

CAST-IRON CONSTRUCTION

Before concluding, a few words should be included on the material employed in benzene stills. For the stills themselves, cast iron must invariably be used and although with steam coils bent from seamless steel tubing a much better heating effect is obtained than with cast-iron elements or cells, the latter are to be given preference, or frequent stoppages and renewals are encountered. Wrought iron is strongly attacked and a

blank flange of 2.5 mm. thickness which the writer applied on the outside of a still was eaten through completely within ten days when the oil leaked out. For the same reason oil preheaters with steel tubes lead to continuous repairs. Two attacking agents are ammonia and cyanides, though of the former only traces should be found in the gas after it has passed the saturators. Ammonia and cyanogen are not easily absorbed by the wash oil, but the latter contains a sufficient quantity of water to saturate them and cause trouble. Ammonia and cyanogen are completely volatilized if the temperature is maintained sufficiently high and the corroding effect of the oil in the still, into which no ammonia or cyanides should be carried over, has for a long time remained a mystery.

CORROSION DUE TO ORGANIC SULPHUR

Quite recently, however, the results of the research of Dr. Weissgerber¹ show that the corroding effect of tar oils on wrought-iron tanks, etc., must be attributed to organic sulphur compounds in the oil, and especially in naphthalene oil. These observations are confirmed by the experience of the writer, who found the corroding effect of the wash oil in the still more pronounced the higher the contents of naphthalene were. It would mean a deviation from the present subject to dwell further upon these interesting investigations, and the conclusion must be drawn that a departure from cast iron in the construction of preheaters and distilling sections in preference to other metals is to be avoided, or heavy and frequent repairs must be reckoned with after a time.

Preliminary Reports of 1919 Census of Manufactures—Sugar and Glass

Preliminary statements of the general results of the 1919 census of manufactures with reference to beet sugar, cane sugar and glass have been issued by the Bureau of the Census. The statistics for 1919 and 1914 are summarized in the following tables, prepared under the direction of Eugene F. Hartley, chief statistician for manufactures. These figures are subject to such change and correction as may be necessary from further examination of the original reports.

BEET SUGAR INDUSTRY

Reports were received from 85 establishments engaged in the manufacture of beet sugar in 1919 and

	1919	1914
Number of establishments.....	85	60
Total value of products.....	\$149,155,892	\$62,605,210
Sugar:		
Pounds.....	1,426,891,315	1,486,947,817
Value.....	\$138,099,693	\$58,590,466
Granulated—		
Pounds.....	1,421,914,425	1,478,466,899
Value.....	\$137,852,387	\$58,351,324
Raw:		
Pounds.....	4,976,890	8,480,918
Value.....	\$247,306	\$239,142
Molasses:		
Gallons.....	18,841,429	26,461,291
Value.....	\$2,364,563	\$1,536,192
Pulp:		
Tons.....	2,082,531	*
Value.....	\$5,798,412	\$2,094,863
Dried:		
Tons.....	976,501	*
Value.....	\$4,829,568	\$1,510,759
Moist:		
Tons.....	1,106,030	*
Value.....	\$968,844	\$584,104
All other products, value.....	\$2,893,224	\$383,689

* Not reported in 1914.

their products for the year were valued at \$149,155,892. At the census of 1914 there were 60 establishments with products valued at \$62,605,210. The value of products therefore has been increased \$86,550,682, or 138.2 per cent.

In 1919 there were 16 establishments each in Michigan and Utah, 14 in Colorado, 10 in California, 8 in Idaho, 5 in Ohio, 4 each in Nebraska and Wisconsin, and 1 each in Illinois, Indiana, Iowa, Kansas, Minnesota, Montana, Washington and Wyoming.

CANE SUGAR INDUSTRY

Reports were received from 202 establishments in 1919 engaged principally in the manufacture of cane sugar. The products for the year were valued at \$57,741,320. At the census of 1914 reports were received from 181 establishments with products valued

	1919	1914
Number of establishments.....	202	181
Total value of products.....	\$57,741,320	\$21,635,373
Sugar:		
Pounds.....	450,955,838	529,601,993
Value.....	\$46,659,085	\$18,947,683
Refined:		
Pounds.....	71,627,346	107,187,416
Value.....	\$9,547,378	\$4,228,860
Clarified:		
Pounds.....	258,293,878	182,149,649
Value.....	\$26,563,156	\$6,742,266
Raw:		
Pounds.....	113,154,404	229,646,354
Value.....	\$9,898,958	\$7,615,147
Brown:		
Pounds.....	7,880,210	10,618,574
Value.....	\$649,593	\$361,410
Molasses:		
Gallons.....	20,058,248	20,675,260
Value.....	\$4,868,740	\$2,021,517
Sirup:		
Gallons.....	6,739,978	2,420,633
Value.....	\$4,189,199	\$609,696
All other products, value.....	\$2,024,296	\$56,477

at \$21,635,373. The value of annual production has therefore increased \$36,105,947, or 166.8 per cent.

In 1919 189 establishments were located in Louisiana, 6 in South Carolina, 3 in Florida, 2 in Georgia, and 1 each in Mississippi and Texas.

GLASS INDUSTRY

In 1919 102 glass manufacturing establishments were located in Pennsylvania, 77 in West Virginia, 43 in Ohio, 35 in Indiana, 21 in New Jersey, 19 in New York, 16 in Oklahoma, 12 in Illinois, 8 in Maryland, 7 in

	No. of Establishments		Production	
	1919	1914	1919	1914
Total for the industry.....	367	348	\$254,709,000	\$123,085,000
Building glass.....	125	102	\$83,718,000	\$36,824,000
Window glass:				
Quantity, sq.ft.....			368,912,209	400,998,893
Value.....			\$41,106,000	\$17,496,000
Obscured glass, including cathedral and skylight				
Quantity, sq.ft.....			33,822,302	43,040,079
Value.....			\$4,300,000	\$2,417,000
Plate glass (made for sale):				
Quantity, sq.ft.....			57,612,491	60,515,008
Value.....			\$33,519,000	\$14,800,000
Wire glass:				
Quantity, sq.ft.....			15,691,486	15,688,844
Value.....			\$2,907,000	\$1,591,000
All other building glass:				
Value.....			\$1,886,000	\$520,000
Pressed and blown glass.....	130	107	\$70,708,000	\$30,279,000
Bottles, jars, etc.....	139	150	\$87,762,000	\$51,959,000
All other products.....			\$12,521,000	\$4,023,000

California, 5 in Kansas, 4 in Missouri, 3 each in Arkansas and Virginia, 2 each in Louisiana, Texas and Wisconsin, and 1 each in Massachusetts, Michigan, Rhode Island, South Carolina, Tennessee and Washington.

¹ *Ercunststoff-Chemie*, vol. 2, p. 1.

Legal Notes

BY WELLINGTON GUSTIN

Grosvenor Process for Hardening Siccative Coatings Held Invention

The United States District Court upholds the validity of the William M. Grosvenor patent, No. 1,186,477, claims 2 and 4, for a process for drying and hardening siccative coatings, in a suit by the Wenborne-Karpen Dryer Co. against the Rockford Bookcase Co.

Siccative coatings are said to be such as varnish, oil paints and oil-containing fillers which harden by oxidation. It was pointed out that hardening of paint was oxidation—a chemical action—while drying or evaporation of water is a physical process. Grosvenor's process was intended to harden the coatings rapidly and to produce them superior to those treated by other processes. It was not claimed to be new in the arts. In its simplest form it consists of simultaneously adding heat and moisture to the air surrounding the siccative coatings. Such a process has been used for years in drying lumber. It was learned early that if lumber were subjected to artificial heat it would dry rapidly, but the outside would become case-hardened. Steam vapor was therefore introduced into the drying chamber simultaneously with the heat circulation procured by fans, etc., and in that way the outside drying was retarded until the inside drying caught up, and the whole dried thoroughly and evenly.

A QUESTION OF PATENTABILITY

The only question, said the court, was whether the old lumber dry-kiln methods, when applied to harden siccative coatings, was patentable. (269 Fed., 144).

It was shown that prior to the Grosvenor process it required from eighteen to forty-eight hours to harden thick varnish, whereas under the new process the same result was reached in from six to eight hours. The so-called drying of paints and varnishes is not the same as evaporating moisture from wood or other products, nor does the use of the earlier lumber dry-kiln process even suggest that it might be used to dry paints, said the court. For years it was thought the introduction of moisture would delay hardening and water was generally kept away from fresh paints. The court held that the old and well-known process referred to was not only applied in a different art, but with a new and different result.

It required genius to discover, thought the court, by experimentation or otherwise, that the old process was suitable for the new use, and would produce a beneficial result therefrom unforeseen. It is apparent that the suitable hardening by oxidation of substances like a siccative film was not suggested by the drying of substances like a porous block of wood; because before the Grosvenor process it was the consensus that moisture was one of the greatest obstacles to the rapid drying of varnish, observed the court.

NO ANTICIPATION, DECIDES COURT

The second defense to the suit was anticipation by patents in the prior art, along with a published article, entitled "Pigments, Paints and Painting," written by

George Terry in 1893, where the author says: "The drying of paint being a process of oxidization and not evaporation, it is essential that a good supply of fresh air should be provided," adding that the presence of moisture in the air was beneficial and tends to counteract the tendency of the paint to crack or shrink. But Terry not only failed to indicate that moisture increased the rate of drying; he made no suggestion of any advantage to be secured by the rapid circulation of currents of air or other oxidizing agents across the surface of the material. Terry at best only anticipated the drying of paint under the action of heat, fresh air and whatever moisture nature happens to give in the air.

Grosvenor took a decided and important step in advance, said the court. His process cuts down the time of drying one-half, and in that way saved huge sums tied up in time and space in the manufacture of articles requiring such coatings. No prior reference or patent points out that the use of moisture in excess of natural humidity would be of any value, if indeed it was not said to be a disadvantage.

The patent was held valid and the usual reference was made for an accounting on the part of defendant.

Crop Surplus Awarded Fertilizer Works Where Surplus Was Due to Fertilizer Used

In a lien creditor's suit by the Armour Fertilizer Works against John W. Taylor and others, the Supreme Court of Appeals of Virginia reversed the lower court and directed that the fund in controversy be paid over to the fertilizer works. Taylor owned valuable farm lands which were heavily encumbered by many deeds of trust and judgments. To enforce these liens a lien creditors' suit was instituted. Later the several tenants who had leased the lands from Taylor purchased fertilizers from the Armour Fertilizer Works for use in making crops, giving their notes for the fertilizers purchased, securing the notes by crop liens duly executed under the Virginia statute.

A sale was had of the lands under direction of the court, under a decree in the lien creditors' suit. After payment of the old liens there was a balance left, applicable to either the crop lien claim or to payment to the trustee in bankruptcy for distribution among general creditors of Taylor who had become bankrupt. On Armour's crop lien claim it was found that the proceeds of the sale of the lands were augmented by the value of the crops, and that such crop value was due to the known and recognized effects of the fertilizer, which had been obtained upon by the security afforded by the crop liens. In other words, the court said the crop liens must be regarded as having produced the surplus.

DECISION SETS A PRECEDENT

The law is that where crops are planted after a mortgage is given on lands the crops pass with the lands for the benefit of the mortgagee, whether planted by the mortgagor or his tenant. No authority was found on the point involved, and the court was forced to proceed on equitable principles. It said the fund in controversy and claimed by the fertilizer works under its crop lien was in existence as a direct result of the sale of fertilizers to the tenants of the landlord, who had agreed or should have agreed in equity and good conscience for that fund to go to the seller of the fertilizer. The trial court's holding that the surplus belonged to Taylor's creditors was therefore reversed and the amount awarded to the fertilizer works.

Gases in Aluminum Furnaces and Their Analysis

**A Number of Common Gases Are Mixed in the Atmosphere of Various Furnaces Melting Aluminum—
The Problem Is to Develop a Portable Gas-Sampling Apparatus Which Will Extract
a Portion From a Desired Spot and Store It for Analysis**

BY ROBERT J. ANDERSON AND J. H. CAPPS

NO SYSTEMATIC studies of the actual constitution of the gas atmospheres prevailing in the interior of industrial metallurgical melting furnaces have been made. The constitution of flue gases in boiler-room practice and in coal-fired furnaces has been examined exhaustively by Kreisinger¹ and others, and is of interest and importance in connection with coal-fired metallurgical furnaces, since many gas analyses are given of the atmospheres obtaining in the fuel bed and in the combustion space.

LITTLE KNOWN ABOUT FURNACE ATMOSPHERES

As to the constitution of the gas atmospheres in the interior of metal-melting furnaces, the available data are very meager. In the publication of the Bureau of Mines on brass-furnace practice,² some analyses of the waste gases from a gas-fired, pit-crucible furnace are reported. The results of these analyses indicated the presence of a slight trace of carbon monoxide, never exceeding 0.40 per cent, and the proper proportions of nitrogen and carbon dioxide, indicating good combustion. Just recently, Bamford and Ballard³ have reported the sampling of gases from points near the top of a coke-fired pit-crucible furnace. In all cases the gases over the crucible contained an excess of oxygen and also small quantities of carbon monoxide ranging from 0.50 to 0.90 per cent. In one case, where the fire had burned down badly, 1.30 per cent hydrogen was found. In no case was there more than a trace of sulphur dioxide, but this is stated to be a condition dependent upon the character of the coke used, since when the coke contains any sulphur the combustion products must show the presence of sulphur dioxide.

It will be plainly evident that the constitution of the gas atmospheres in most industrial melting furnaces will be dependent upon a number of governing factors. The most important of these are the following: (1) Kind and quality of the fuel used; (2) type and design of the furnace; and (3) operating conditions.

KINDS OF FURNACES USED IN ALUMINUM MELTING

In large foundries, the stationary and tilting iron-pot furnaces appear to be favored considerably, but the tilting open-flame furnaces are also used a good deal. In small foundries, pit furnaces, using a plumbago crucible for both melting and pouring, are still employed

quite largely. Electric furnaces for melting aluminum and its light alloys are just now receiving considerable attention, and a few installations have been made. In the case of melting and smelting furnaces for aluminum and light aluminum-alloy borings, scrap and drosses, the domestic practice is not standardized. For smelting borings and other light scrap for the production of so-called "casting aluminum," stationary iron-pot furnaces, reverberatory furnaces, pit furnaces and tilting, open-flame furnaces are employed commercially. Experiments have also been made on the electric smelting of these materials.⁴ More recently a number of companies have made preliminary studies of the electric smelting of light aluminum-alloy borings, but no electric furnace is operating commercially on such material at the present time.

CONSTITUENTS OF MELTING-FURNACE ATMOSPHERES

It will be shown in a later contribution by detailed lists of analyses that the constituents which may be present in various furnace atmospheres vary widely as to kind and amount.

Carbon dioxide is a frequent constituent in the atmospheres of practically all types of furnaces used in the commercial melting of aluminum and its light alloys. The complete combustion of fuel results in the conversion of all the carbon, in whatever form, to carbon dioxide.

Carbon monoxide is a frequent constituent of melting-furnace atmospheres. In certain types of furnaces, it is normally present in small percentages under ordinary operating conditions, but the amount contained in the atmosphere can be varied within wide limits by varying the method of firing. A high carbon-monoxide atmosphere is normal in most electric furnaces.

Free cyanogen is of comparatively rare occurrence in furnace atmospheres used for melting aluminum and its light alloys. Cyanogen is formed in small amount when a discharge of electricity takes place between carbon electrodes in the presence of nitrogen. Thus, cyanogen is normally present in small amount in arc-type electric furnaces.

Hydrogen is normally regarded as a reducing gas; it is a frequent constituent in fuel-fired furnace atmospheres in small but variable amounts, and it has also been found in the atmospheres of electric furnaces. The presence of hydrogen in a fuel-fired furnace atmosphere normally indicates incomplete combustion, since the combined or free hydrogen in a fuel should burn to water.

Methane, in small but appreciable amounts, occurs in the atmospheres of furnaces fired by methane-containing fuel, due to incomplete combustion. It can scarcely

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²Kreisinger, H., and Ovitz, F. K., Sampling and Analyzing Flue Gases, Bureau of Mines Bull. 97, August, 1915. Kreisinger, H., Ovitz, F. K., and Augustine, C. E., Combustion in the Fuel Bed of Hand-Fired Furnaces, Bureau of Mines Tech. Paper 137, September, 1916. Kreisinger, H., Augustine, C. E., and Katz, S. H., Low-Rate Combustion in Fuel Beds of Hand-Fired Furnaces, Bureau of Mines Tech. Paper 139, June, 1918. Also see related papers of the Bureau of Mines quoted in the above publications.

³Gillett, H. W., Brass-Furnace Practice in the United States, Bureau of Mines Bull. 73, second ed., June, 1916, p. 99.

⁴Bamford, T. G., and Ballard, W. E., The Influence of Gases on High-Grade Brass, paper read before the Institute of Metals, Sept. 15, 1920, Barrow-in-Furness meeting.

⁵Gillett, H. W., and James, G. M., Melting Aluminum Chips, Bureau of Mines Bull. 108, August, 1916.

be doubted that no methane is formed by the direct union of carbon and hydrogen. The occurrence of free methane in a furnace atmosphere indicates incomplete combustion, since methane burns to carbon dioxide and water in air.

Nitrogen is a normal constituent of all furnace atmospheres, being derived from the air. It is, of course, evident that nitrogen will always constitute a large percentage of the atmosphere in any fuel-fired furnace, since air is required for combustion.

Free, uncombined oxygen may be present in varying amounts in the atmospheres of industrial melting furnaces operating on aluminum and its light alloys. Ordinarily, free oxygen is the result of a large excess air supply, but it is possible that considerable carbon monoxide may be present in furnace gases together with some oxygen. This condition is stated by Gillett³ to be common in industrial melting furnaces when the attempt is made to avoid an oxidizing flame. At the same time, free oxygen is normally present in open-flame furnaces when run with an excess air supply; here, both oxygen and carbon dioxide may be present in large percentages, together with nitrogen and other gases. As in the case of other constituents of furnace atmospheres, the oxygen percentage depends upon the type of furnace, upon the fuel used and upon the operating conditions.

Sulphur dioxide may be present in furnace atmospheres in appreciable amounts when high-sulphur fuel is used. It results from the combustion of the sulphur in fuels, and at least small amounts occur normally in furnace atmospheres.

Unsaturated hydrocarbons in a furnace atmosphere normally come from the fuel used and are the result of incomplete combustion. The percentages present in various furnace atmospheres are usually quite low. No examination of the effects of unsaturated hydrocarbons upon the properties of aluminum and its light alloys has been made so far as is known.

Water vapor is a constituent of many furnace atmospheres, and it results from the combustion of free or combined hydrogen. The amount of water vapor in an atmosphere at high temperature is not readily determinable quantitatively, since the water vapor condenses on exposure to temperatures below 100 deg. C. From the chemical analysis of the fuel used, it is possible, however, to gain an idea of the amount of water vapor produced on combustion.

PORTABLE SAMPLING APPARATUS

In view of the influence which correct atmosphere control undoubtedly has upon melting losses, the Bureau of Mines resolved to make an effort to supplement the meager data now available on the composition of furnace atmospheres.

Most of the furnaces from which the gas samples were taken were located in plants several hundred miles from the Pittsburgh station of the Bureau of Mines. Hence it was necessary to devise a portable sampling apparatus for taking the gas samples. The apparatus described below has proved to be entirely satisfactory for the authors' purpose, and it is believed that the method of drawing off the gases by means of the mercury "pump" will be found preferable to any aspirating device. The apparatus as devised can be readily packed in a small box for shipment, and it can be carried about

in the plant for set up at a given furnace. The gas samples collected from furnaces at different plants throughout the country were contained in heavy glass bottles fitted with a spring cork and a rubber gasket. They were packed in excelsior at the plant where the samples were taken and shipped to the gas laboratory at the Pittsburgh station for analysis.

The portable sampling apparatus used for the removal of samples from furnace atmospheres is shown in Fig. 1. Tube *a* is attached to a fused silica tube, 4 ft. long, $\frac{1}{4}$ in. internal diameter and $\frac{3}{4}$ in. external diameter which is placed in the furnace so that gases may be drawn through it. Part *b* is a rubber tube, of the heavy-walled pressure type. A 20-ft. length is sufficient for most conditions met with in furnace installation. Part *c* is a glass bulb of about 100 c.c. capacity mounted upon a support.

SAMPLING PROCEDURE

In collecting the gas samples from the atmospheres of the various furnaces, the method for drawing off and holding the gas was the same throughout. The detailed method for obtaining a gas sample is as follows: The

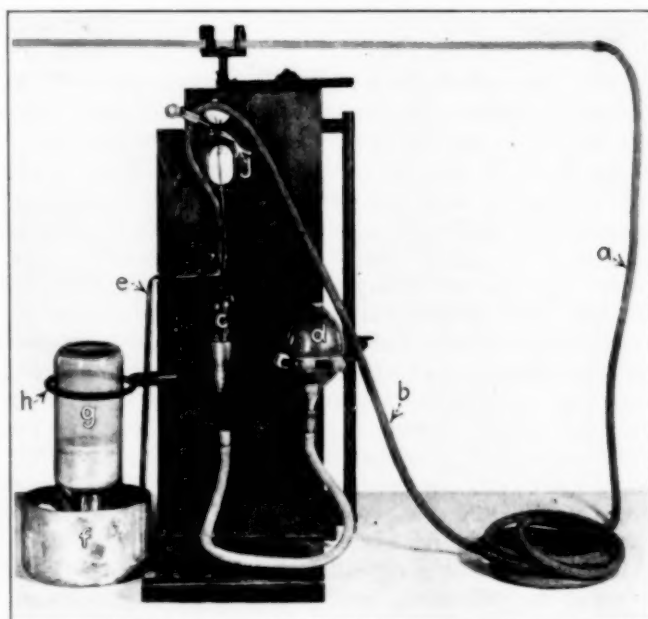


FIG. 1. PORTABLE DEVICE FOR SAMPLING FURNACE ATMOSPHERES

sample bottle *g* is filled with mercury and sealed with the rubber spring stopper; it is then inverted in the ring stand *h* into the dish *f*, which contains sufficient mercury to seal the mouth of the bottle when the stopper is opened. Bulbs *c* and *d* contain mercury in the amounts indicated in Fig. 1—i.e., when the mercury in both bulbs is at the same level the bulbs are each about half full. The actual amount of mercury required for manipulation depends upon the size of the bulbs and the connecting tube. With the sampling tube placed in position in the furnace atmosphere to be sampled, pinch cock *j* is opened and the delivery tube *e* is placed in such a position that it may exhaust gas into the mercury in the dish *f* but not into the bottle *g*, which is not opened until the apparatus is thoroughly "washed."

Bulb *d* is now lowered, the falling mercury in *c* causing gas to be drawn from the furnace through *a* and *b* and into *c*. The tube *b* is then closed by the pinch cock *j*, thus preventing the egress of gas through that line on raising *d*. When *d* is now raised, the mercury rising in *c* expels the gas, drawn into *c*, through *e*, through the

³Gillett, H. W., *Brass-Furnace Practice in the United States*, Bureau of Mines Bull. 73, second ed., June, 1916, p. 214.

mercury, and into the air. The apparatus is washed through with furnace gas from six to fifteen times before admitting gas to the sample bottle. When ready to deliver gas to the sample bottle, assuming that a quantity of gas is inclosed in *c*, the sample bottle is uncorked under the mercury in dish *f*; the end of the delivery tube *e* is inserted into the neck of *g*, and by raising the bulb *d* (*j* being closed), gas is delivered to the bottle. Then *b* is opened at *j*, and the operation is repeated until the sample bottle is full of gas, the mercury having been displaced and discharged into the dish *f*. The mercury in *f* acts also as a seal for *e*, thereby preventing ingress of air when *j* is opened and *d* is lowered.

As indicated, the "pump" is operated until the sample bottle is full, after which the bottle is sealed with the stopper, still under the mercury, removed, labeled, and its whole neck with stopper dipped in liquid paraffine to insure an air-tight seal. With this apparatus, samples can be taken at the rate of one every four or five minutes. Changes in the composition of a furnace atmosphere and variations in furnace operation can thus be detected during the course of a complete melting period.

In general, the open end of the sampling tube was placed in a position at about the center of the interior of the furnace and very near the surface of the liquid melt, say $\frac{1}{2}$ to 1 in. from the surface. In all cases the aim was to secure samples of the gas in contact with the alloy. For open-flame tilting furnaces, and in some closed furnaces, the sampling tube was admitted into the interior of the furnace through a hole in the door or through the pouring spout and luted firmly with clay. The intention for all furnaces was to bring the intake end of the tube to a position in about the center of the furnace and very near to the surface of the liquid alloy. This was not possible in the rocking-type indirect-arc electric furnace, nor in other furnaces under some conditions—such as in the early stages of a melt when the interior was filled with bulky scrap. In such cases the sampling tube reached well into the furnace, although not to the center. For open iron-pot furnaces and crucible furnaces, the sampling tube was simply supported by a stand in such a way that the intake end reached to within about one inch of the bath near the center.

GAS ANALYTICAL METHODS

In the analysis of the various gas samples a Bureau of Mines modified Orsat apparatus was used. Detailed description of the apparatus or of the methods employed for the determination of the constituents of the samples is not necessary here, since these subjects have been treated fully in other publications* of the Bureau of Mines. Briefly, the different constituents in the gas samples are determined as follows: Carbon dioxide is determined by absorption in potassium hydroxide, oxygen by potassium pyrogallate solution, and unsaturated hydrocarbons by fuming sulphuric acid. Hydrogen and carbon monoxide are determined by the copper-oxide combustion method and saturated hydrocarbons by slow combustion. Cyanogen is determined by absorption in 2.0 per cent sodium bicarbonate solution and titration with standard iodine.

Pittsburgh, Pa.

*Burrell, G. A., and Seibert, F. M., The Sampling and Examination of Mine Gases and Natural Gas, Bureau of Mines Bull. 42, 1913. Burrell, G. A., and Oberfell, G. G., The Use of Copper Oxide for Fractionation Combustion of Hydrogen and Carbon Monoxide in Gas Mixtures, *J. Ind. Eng. Chem.*, vol. 8, 1916, pp. 228-231. Jones, G. W., and Neumeister, F. R., An Improved Orsat Apparatus, *CHEM. & MET. ENG.*, vol. 21, 1919, pp. 734-736.

Growth of the American Sulphur Industry

During the year 1910 crude sulphur imports into the United States totaled 28,648 long tons, valued at \$495,988, or an average of \$17 per ton. These figures were closely related to the domestic exports of brimstone and other refined forms, amounting to 30,742 tons, invoiced at \$552,941, an average export price of \$18 per ton.

For the calendar year 1920 imports were only 44 tons, valued at \$1,722. The domestic exports of sulphur amounted to 477,450 tons, worth \$8,994,350. From 1880 to 1903, the average annual importation was approximately 100,000 tons. Since 1907, annual imports have never gone above 30,000 tons. The average was about 20,000 tons. Receipts have been considerably lower since 1917.

Domestic sulphur was originally exported in 1904. In 1907, for the first time exports exceeded imports. From 1906 to 1911, about 30,000 tons was exported annually, increasing more than fifteen times, to 477,450 tons, in 1920.

The decline of imports followed the development of the Louisiana deposit, the first to be discovered in the United States. According to the United States Geological Survey, early attempts to mine the Louisiana deposits were unsuccessful, until the double problem of reaching the deposit and extracting the sulphur was solved by Dr. Herman Frasch. The original Frasch patents having expired, the same general process is now in use, both at the original locality and at Freeport, Tex., the next most important center. The United States Geological Survey has more recently investigated additional sulphur deposits in New Mexico and Alaska.

Exports in 1916 exceeded imports by 107,000 tons and were valued at over \$2,500,000. They showed increased valuation for each year thereafter. The annual growth in the export trade and the corresponding decline in imports during the past eleven years is shown in the following table, compiled from statistics from the Bureau of Foreign and Domestic Commerce:

EXPORTS AND IMPORTS OF SULPHUR 1910-1920

	Exports		Imports	
	Tons	Value	Tons	Value
1910.....	30,742	\$552,941	28,647	\$495,988
1911.....	28,103	545,420	24,250	436,725
1912.....	57,736	1,076,414	26,885	494,778
1913.....	89,221	1,599,761	14,636	278.56
1914.....	98,163	1,807,324	22,810	409,537
1915.....	37,271	724,679	24,647	405,990
1916.....	128,755	2,505,857	21,510	364,787
1917.....	152,736	3,500,819	973	20,176
1918.....	131,092	3,626,638	55	1,692
1919.....	224,712	6,325,552	77	1,997
1920.....	477,450	8,994,350	44	1,272

French Steel Companies Combine

Through the office of the commercial attaché at Paris it is learned that three of the largest steel corporations in France have recently combined. The principal company of the new combine is the Société Anonyme des Forges et Aciéries du Nord et de l'Est, the capital of which is to be increased from 46,000,000 to 86,000,000f. It will absorb the holdings of the Société des Forges et Aciéries du Nord et de Lorraine and of the Usines Métallurgique de la Basse-Loire. It is stated that the new company will control an ore domain with equipment for an annual production of 4,000,000 tons, and also six large French coal companies and important coal deposits in England as well as coke, cement and building material companies, rolling mills, foundries and casting plants.

Some Chemical Considerations of Petroleum Refining*

Factors Influencing a Change in Attitude of Petroleum Refiners Toward Chemical Research and Development of Non-Benzenoid Hydrocarbon Chemistry—Unsaturated Hydrocarbons Misunderstood—Polymerization Phenomenon Should Be Studied

By BENJAMIN T. BROOKS

PROF. IRVING FISHER in outlining his analysis of reconstruction problems has made use of the headings, "1. What is it? 2. Why is it? 3. What of it? 4. What are you going to do about it?" and it seems to me these questions may well be asked in discussing the chemical aspects of petroleum refining.

One might seriously debate the question whether or not there is such a thing as the chemical technology of petroleum. As to whether or not there *may* be a chemical technology of petroleum is another question, and I believe that this possibility is one of the best reasons for the formation of a petroleum section of the American Chemical Society. It is not the purpose of this discussion to quibble over definitions, but I believe that most of us will agree that while we have a more or less specialized technology of petroleum, chemistry has thus far played a relatively unimportant part in this industry. Many of us believe that chemistry should have played a much more important part in the technology of petroleum and the utilization of its products than it has done in the past, and that it is destined to do so. Let us attempt to analyze this situation and find out the reasons why.

Petroleum has been plentiful and it has until quite recently yielded handsome profits when simply burned as fuel. Greases and lubricants at least as good as anything to which the public was accustomed were easily made; not much chemistry required here. Petroleum has been so plentiful that refiners have often been hard pressed to take care of it; "throughput" has been the first consideration and only the simplest refining operations were permitted.

Research has been regarded as a kind of "wildcatting" in which the chances of success were not very good, the objectives often hazy and indefinite and not well understood; the gulf between scientific men and "practical oil men" has been very wide indeed. Burton's cracking process is the one important exception of a process having been originated and developed entirely by the works. This process and its demonstrated success is the best sign that the character of works management is changing. The Gulf Refining Co. has maintained a small research organization in the Mellon Institute for several years.

Work that has been done by chemists in the employ of oil companies has usually been buried, owing to the supposed value of secrecy and to the inertia of conservative oil producers of the old school. No one knows how much valuable work has been done and practically lost or buried in this way. Under these conditions initiative and the incentive to investigation are killed.

There exists no journal or publication which is recognized as serving the interests of petroleum technology, with the result that such few matters as are published

are scattered in a number of publications of indefinite or heterogeneous character. Petroleum investigations published in this way get lost in the shuffle and their message does not "get across." At present chemists interested in petroleum research are inarticulate.

There is a broad gap between petroleum technology and theoretical organic chemistry, and in this connection it should be emphasized that comparatively little systematic work in the chemistry of the non-benzenoid hydrocarbons which should serve as the fundamental groundwork of petroleum investigations has been done. Easily 80 per cent of the work which has been done must be credited to Russian chemists.

Poor training and narrowness of chemists; a chemist must be vastly more than an analyst to be of great service in this or in fact any industry.

FACTORS INFLUENCING A CHANGE

Let us see if there are any factors now operating which may change this state of affairs. I believe the following are likely to prove important.

Compared with demand, petroleum is much less plentiful than in former years. Its use as fuel has already ceased in many localities, and the cost of gas oil, for the manufacture of carburetted water gas, has become almost prohibitive.

Greater flexibility in refining operations is demanded so as to increase the production of the more valuable products.

The quantity of high-grade crudes, such as that of Pennsylvania, is relatively much less than ever before and it is far more difficult to manufacture products of satisfactory quality from oils such as Mexican or Californian oil.

The large refining losses resulting from treatment of highly unsaturated oils, together with the general economic situation, alluded to above, makes a study of refining, with the object of eliminating or minimizing these losses, almost imperative. Pyrolysis of oils as in the Burton process is now an indispensable process; shale oils and oils from the low-temperature carbonization of coal are on the way and the losses resulting on refining such oils by ordinary methods are very large indeed. In spite of the many years of oil-shale practice in Scotland, the losses on refining are enormous, and it may be said that no satisfactory method of treating these oils exists today.

The reaction of the automobile industry on the petroleum industry has been to emphasize the need of getting down to bed rock fundamentals, particularly as regards motor fuels, lubrication and the study of lubricating oils, their refining, carbonization, air oxidation, etc.

Following the lead of the Russians in the application of scientific research to petroleum, the Anglo Persian Oil Co. has established a large research laboratory in

*Read before the Petroleum Section of the American Chemical Society, Rochester, N. Y., April 27, 1921.

England under the direction of an able theoretical chemist, Dr. Dunstan. American petroleum interests probably will follow these leads. The American Petroleum Institute will undoubtedly be strongly influential in bringing this about.

NON-BENZENOID HYDROCARBON RESEARCH

A larger number of men, well trained in chemistry, are available than ever before. University laboratories are more handsomely equipped and the number of post-graduate students in chemistry is greater than ever before. If interest in the chemistry of the non-benzenoid hydrocarbons is stimulated, we may yet acquire the necessary fundamental information which petroleum research needs so badly. Such research should be systematic and broad in scope and will require the labor of many for a long period of years. Work of this kind in Russia has practically ceased, and American organic chemists may well give this field of work its due share of attention.

The formation of this petroleum section may promote chemical research on petroleum products and assist in placing chemistry in a more important relation to this industry. Dr. R. B. Sosman, president of the Philosophical Society in Washington, has recently called attention to the difficulties in the way of utilizing scientific information which arises from the great volume and heterogeneity of published scientific research and the wide gap which exists between isolated producers of scientific information and others who can apply or make use of it. It is worth while to recall that American investigations of interest to petroleum technologists have been published in a number of different journals, so that this literature is scattered and inaccessible to many. These considerations were partly responsible for the formation of the Institute of Petroleum Technologists in England, which now publishes an admirable journal. American investigations relating to petroleum have been published chiefly in the *Bulletin of the American Institute of Mining Engineers*, *Engineering and Mining Journal*, *CHEMICAL & METALLURGICAL ENGINEERING*, *Journal of Industrial and Engineering Chemistry*, *Journal of the American Chemical Society*, *American Chemical Journal*, *Proceedings of the Philosophical Society of Washington*, *American Journal of Science*, *Journal of the Franklin Institute*, and also many trade journals, which are filled with personalia, pictures of gasoline-filling stations and like matter, which very few libraries consider valuable enough to bind and preserve. In addition to this, there are a large number of Government bulletins and, as Dr. Sosman has so well pointed out, matters of real value may become submerged in the enormous flood of wood pulp which is thus fed through our printing presses. In view of this scattering of petroleum literature in this country, works such as Bacon and Hamor's recent volumes should be particularly welcome, and one of the most valuable results which this section might possibly bring about is the centralization of material published in America relating to petroleum.

Most large industries have passed through a stage in which secrecy was much prized. Each manufacturer imagined that he possessed keys to mysteries which others did not possess. As instances of this I need only mention the steel industry, the metallurgy and refining of copper, zinc, lead, aluminum, nickel and other metals, the paint and varnish industry, the electrochemical industry, the refining of sugar—and many

others might be added to this list. It may be conceded that in matters of industrial importance, and particularly in the case of patentable matter, a delay in publication sufficient for patent protection is reasonable, but beyond this there is no excuse for the burying of scientific information in private office records. I do not believe that well-informed and progressive business men would consider this question to be a subject of debate, and yet certain petroleum refiners adhere to the old policy, and it may be noted that such refiners are usually the kind who refer to the person whose duties are to make flash point and viscosity determinations as their "chief chemist." The latter remarks are not made in any spirit of criticism merely—in fact such testing work has to be done—but if chemical investigation of petroleum and refinery problems is ever seriously undertaken, the so-called "chief chemist" will not be one whose duties are almost solely taken up with routine tests on the refiners' products.

WHAT CONSTITUTES REFINERY PRACTICE

As regards the refining of petroleum products, we may well use Prof. Fisher's expression, "What is it?" and ask "What does refining really consist in?" Opinions may differ, and usually do, as to what constitutes refining and whether or not a given oil is "refined," "well refined," "poorly refined," "properly refined" or "suitably refined" for a given purpose and what not, but I believe the only answer or definition of refining which can at present be given is substantially this: *Doctoring it, so it will sell.* Petroleum products are "refined" according to the dictates of the salesmen and the standards to which the public has become accustomed. People outside of petroleum refineries object to offensive odors, and therefore one of the first requirements of a refined oil is that its odor shall not be unduly offensive. People generally like pretty colors and the public has become accustomed to insist upon water-white oils in certain cases, light yellow or amber oils in others, pretty red ones in other cases, or oils with a pretty green, bronze or blue fluorescence, as the case may be. The public has become accustomed to and expects these properties in certain oils, but does not expect petroleum oils to be perfumed or colored pink. These physical properties, odor and color, are mentioned in the first place as they are most conspicuous and have considerable to do with the salability of these products, but have little or nothing to do with their suitability or relative excellence in their usual applications.

UNSATURATED HYDROCARBONS MISUNDERSTOOD

One class of hydrocarbons which has been considerably discussed, particularly since the development of the now well-established processes of pyrolytic decomposition, as for example, the Burton process, is the class known as olefines or unsaturated hydrocarbons. Previously the general notion has been that refining consists essentially in removing these unsaturated hydrocarbons, and practically everything in the calendar which could be considered objectionable in an oil, including odor, was attributed to the presence of unsaturated hydrocarbons. But in the case of gasoline or motor fuel it has been shown by Hall and others that ordinary simple olefines behave just as well in internal combustion engines as saturated hydrocarbons; perhaps a little better. In fact, several years ago at the Mellon Institute Dr. Harry Essex made very satisfactory block tests on an automobile engine running entirely on unsatur-

ated hydrocarbons, even turpentine doing very well considering its boiling point and volatility, once the engine had become warm. Offensive odors in motor fuels are due to relatively very small proportions of derivatives containing sulphur, nitrogen and naphthenic acids, and these malodorous constituents can be completely removed independently of the unsaturated hydrocarbons and the resulting motor fuel may be quite superior in odor, and keeping qualities as regards color, to most of the gasoline marketed today.

The economic importance of an adequate supply of motor fuel is such that the unsaturated hydrocarbons present, which in the aggregate represent many millions of gallons, particularly in the case of cracked oils, should not be removed unless it can be conclusively shown that there is good reason to do so. In fact, I have shown in a previous paper on the subject,¹ that refining by ordinary sulphuric acid does not remove all of these olefines, but polymerizes a considerable proportion of them to higher boiling hydrocarbons, which are themselves unsaturated. The presence of these polymers in refined motor fuel may be objected to on the ground of their high boiling point, but not on account of their chemical unsaturation. It would undoubtedly be better to leave the original volatile unsaturated hydrocarbons in the motor fuel than to partly remove and partly polymerize them, as is done in ordinary refining, resulting in loss and in introducing heavy oily residues into the refined product.

In this connection it is worth while to point out that there is no analytical method which gives at all accurately the per cent by volume of unsaturated hydrocarbons in mixtures such as commercial motor fuel or other petroleum products, and in my opinion it is not worth while to seek such an analytical method. These unsaturated hydrocarbons have in the past merely served the purpose of something on which to blame all sorts of troubles and have often been used merely as a cloak for our ignorance. Founded upon some of these notions is the idea that they should be hydrogenated to saturated hydrocarbons and that this would constitute an excellent refining method. At least as regards odor it would do nothing of the sort, and in the case of lubricants the writer agrees with Dunstan that it would be preferable to have larger proportions of them in such oils.

RESINOUS DEPOSITS

It is well known that highly cracked oils leave a thick resinous deposit on slow evaporation in air, and this might conceivably lead to carburetor troubles if such oils were used, but Hall has shown that these resin-forming constituents, present in exceedingly small proportions, can be removed by fullers earth. These resin-forming constituents are probably conjugated unsaturated hydrocarbons, illustrated by isoprene, dimethylhexadiene, cyclohexadiene and the like, which, as is well known, tend to resinify in contact with air. These conjugated diolefines also react very energetically with concentrated sulphuric acid, and this behavior is particularly pronounced in crude benzene from water-gas tar, the light condensate from Pintsch gas and the like. That ordinary unsaturated hydrocarbons, containing one double bond, do not exhibit this behavior has been definitely established—in fact, even pure olefines, with no saturated hydrocarbons present, do not yield

tars with ordinary concentrated sulphuric acid at ordinary atmospheric temperatures, but, on the contrary, the most reactive ones, amylenes and hexylenes, give amber-colored solutions in sulphuric acid. On standing these solutions give steadily increasing proportions of light, amber colored, oily polymers, which form an upper supernatant, oily layer. In the case of the usual hydrocarbon mixtures these polymers are found in the so-called refined oil.

When we consider the refining of lubricating oils we encounter another set of trade customs and prejudices, together with a series of unsolved scientific problems, the most important of which is naturally the subject of viscosity and lubrication. Every one knows that when an unrefined lubricating oil distillate is allowed to stand it darkens rapidly in color, and this proceeds from the exposed surface gradually downward until the whole oil has become very dark in color. This phenomenon is evidently one of air oxidation. As usual, following the old formula, the blame is put upon olefines. However, viscous oily polymers consisting entirely of unsaturated hydrocarbons do not show this behavior. This has been shown in the case of polymers of a wide variety of olefines including amylenes, hexylenes, octenes, decenes, including unsaturated cyclic hydrocarbons of the terpene type, and other unsaturated hydrocarbons of 12 to 18 carbon atoms, either pure, made synthetically or derived from the decomposition of natural waxes and fatty acids. The substances which cause this development of color may easily be minor constituents constituting less than 1 per cent of the crude lubricating distillate, but just what they are we do not know.

TAR-FORMING CONSTITUENTS

It may also be pointed out that unsaturated hydrocarbons, so far as these are actually known, are increasingly stable to sulphuric acid as the molecular weight increases, and do not form tars. As to what the constituents of crude lubricating distillates are which do form the tars observed in refinery practice we do not know, but it does not get us anywhere simply to follow the old tradition and say that the cause of these tars is olefines. We know practically nothing regarding the constitution of the unsaturated hydrocarbons obtained by the polymerization of simpler olefines by sulphuric acid, zinc chloride, fullers earth and the like, but it is practically certain that aluminum chloride acts much more energetically and that the products obtained by its action do not contain ethylene hydrocarbons.

UTILIZATION OF POLYMERIZATION

Is it worth while, from a practical standpoint, to study this question of polymerization? Personally, I am convinced that it is, and a first attempt to utilize this phenomenon in a practical way was made recently by Brownlee, who during the recent war period made lubricating oils by the polymerization, by means of aluminum chloride, of unsaturated hydrocarbons, made by pyrolytic decomposition of gas oil distillate or other cheaper oils. Dunstan in England has suggested that it is desirable to retain olefines in lubricating oils and that they may have lubricating qualities superior to the saturated hydrocarbons. Every possible means of reducing the present large refining losses must be carefully considered. The refining of lubricating oils should, therefore, be carefully studied with the object of discovering methods of refining which will accomplish

¹J. Am. Chem. Soc., vol. 40, p. 822 (1918).

the particular results desired and *no more*. Whether or not Dunstan's contentions are correct should be easily capable of experimental proof or disproof, and Archbutt has recently suggested that such questions be settled once and for all time by studying the behavior of different types of hydrocarbons, either made by synthesis or isolated from commercial oils. When the days of "slaughtering" crude petroleum are over—and they are rapidly passing—research on such problems will be imperative. A study of our production statistics indicates that if the refining losses of lubricating oils could be halved many millions of gallons would be added annually to our supply of lubricating oils.

Brownlee's process of making lubricating oils by polymerization of oils which by themselves are too fluid for lubrication is particularly suggestive and, it may be noted, is a change diametrically opposed to cracking processes. One of the most valuable features of the Burton process is that it gives considerable flexibility to the refinery operations, and the polymerization process should also be of increasing value on this account.

TESTING FOR LUBRICATING VALUE OF OILS

In connection with Dunstan's claim as to the lubricating value of unsaturated hydrocarbons, it may be pointed out that none of the testing methods now employed are any measure of the film strength of a lubricating oil. Physical chemists have pointed out that for a liquid to lubricate two moving surfaces the liquid must be adsorbed by the solid surface, and that the thickness of the effective lubricating film is of the order of 10^{-7} cm., or, in other words, of the order of one to two molecules in thickness, and that flooding a bearing with more oil does not improve lubrication. During the war the value of castor oil or additions of 1 to 2 per cent of free fatty acids to a lubricating oil was clearly shown, this benefit chiefly consisting in greater tenacity or wetting power of the oil for the metal. So far as I am aware there is no term which expresses precisely this property, although the terms "oiliness" and "body" connote something of this behavior. In a moving bearing, under heavy duty, the tendency is for the oil to be squeezed from between the moving surfaces, and if the oil film has not sufficient tenacity or adhering power the film will be broken and metal to metal friction will result. Viscosity measurements, together with years of observation and experience with lubricating oils, has come to be generally considered as being roughly parallel to, if not a measure of, this film stability or film tenacity. Given this analysis of the problem, any reasonably competent mechanic could devise an instrument which would measure this property of oils in a way which would constitute a much more rational means of determining the lubricating value of different oils.

ECONOMIC VALUE OF RESEARCH

It is not too much to expect that economies which can be effected through better refining methods will more than cover the sum total of the cost of all petroleum investigations, even should these investigations be undertaken on a very large scale indeed. Other possible results of research might, therefore, be reckoned as pure gain, and it is worth pointing out in this connection that the actual experience of manufacturers who maintain research is that the big difficult problems yield by far the greatest financial returns in the long run, as compared with the benefits of solving a multitude of easy little problems.

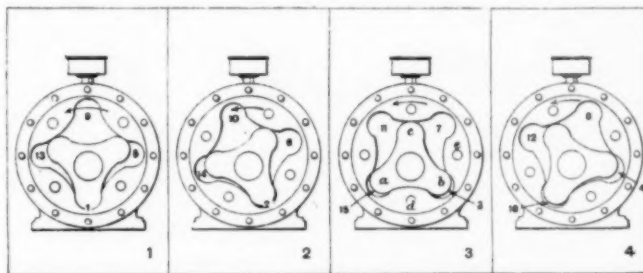
A New Principle of Rotary Pump Construction

BY S. H. FARKAS

THE rotary types of pumps thus far evolved may be divided broadly under the classifications: those using the rotary gear movement, the rotary plunger, and the rotary bucket and packing strip. Practically all these various types require continual replacements, due to the friction taking place either between the moving parts themselves or between the moving parts and the casing.

The illustrations, Figs. 1 to 4, show the two rotating elements of the Exeter rotary pump in sequence of position during one complete revolution. Fig. 5 shows the geometrical construction employed in the design of the two rotors.

Taking Fig. 5 first, an equilateral triangle ABC and a square of equal side are erected on a common base AB .



FIGS 1 TO 4. SEQUENCE OF ROTOR POSITIONS

The angles of the triangle are bisected and the lines produced; the diagonals of the square are also drawn and produced. The circumscribing circles of both triangle and square are also drawn. It will be seen that at the bottom of the figure a distance X is obtained by the intersection of the two circumscribing circles. With the points of the triangle as centers, circles with radii equal to one-fourth of the common side of the triangle and square are described. With O as center and OF as radius, the diagonals of the square are intersected; from the points so found as centers and with one-fourth the common side of the square and triangle as radii, circles are described. The joining arcs for the completion of the square figure are struck with the height of

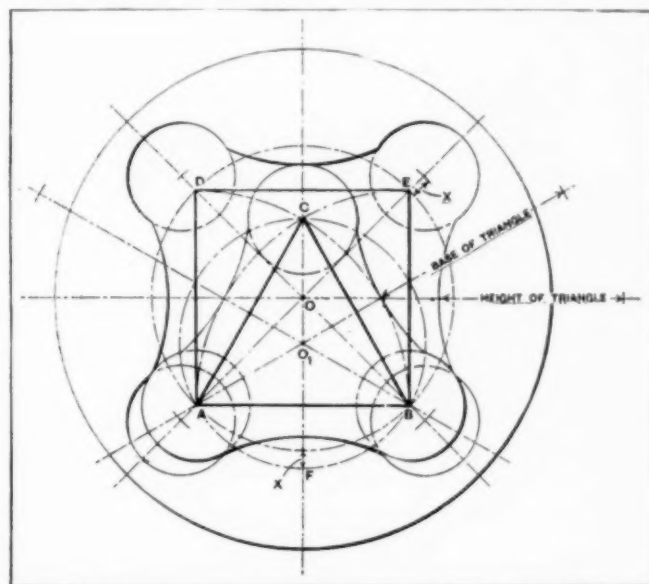


FIG. 5. GEOMETRICAL CONSTRUCTION OF DESIGN

PERFORMANCE TESTS									
Power			Pump						
R. p. m.	Dyn. Scale	B. Hp.	Disch. Hd., Ft.	Suc. Hd., Ft.	Total Hd., Ft.	Hook Gauge	Gal. p. m.	Water, Hp.	Eff., per Cent
500	0.87	0.55	4.0	3.3	7.3	0.296	52.8	0.099	18.0
	1.20	1.50	62.0	2.7	65.7	0.290	51.2	0.85	56.7
	1.57	2.56	126.0	2.6	128.6	0.287	49.9	1.62	65.3
	2.10	4.04	182.0	2.5	184.5	0.283	48.3	2.25	55.8
700	0.82	0.563	4.0	4.7	8.7	0.337	75.2	0.167	24.2
	1.18	2.02	70.5	4.6	75.1	0.334	73.4	1.39	69.0
	1.55	3.50	131.0	4.4	135.4	0.330	71.0	2.43	69.5
	1.95	5.13	199.0	4.3	203.3	0.326	69.0	3.54	69.0
900	0.81	0.675	4.0	6.9	10.9	0.377	100.2	0.276	40.9
	1.16	2.49	67.0	6.6	73.6	0.373	97.8	1.82	73.0
	1.49	4.20	125.0	6.6	131.6	0.368	94.4	3.14	74.7
	1.89	6.28	194.0	6.5	200.5	0.365	92.0	4.65	74.1
1,000	0.87	0.748	4.0	7.0	11.0	0.391	108.7	0.302	40.3
	1.12	2.53	61.5	6.5	68.0	0.389	107.4	1.85	73.0
	1.47	4.55	119.0	6.3	125.3	0.385	105.0	3.32	73.0
	1.82	6.57	175.0	6.2	181.2	0.382	103.2	4.72	71.8
1,200	0.87	1.31	5.0	8.6	13.6	0.420	129.0	0.433	33.8
	1.17	3.39	62.0	8.4	70.9	0.420	129.0	2.31	68.1
	1.52	5.81	124.0	8.3	132.3	0.417	126.6	4.23	72.7
	1.85	8.08	177.0	8.2	186.2	0.413	123.6	5.80	71.8
1,400	0.93	2.01	7.0	9.5	16.5	0.426	133.8	0.557	27.6
	1.25	4.59	64.5	9.5	74.0	0.426	133.8	2.50	54.5
	1.57	7.16	123.0	9.3	132.3	0.423	131.4	4.40	61.3
	2.00	10.6	195.0	9.3	204.3	0.421	129.8	6.70	63.1

the initial triangle as radius, while the similar arcs on the triangular figure are struck with the side of the square or triangle as radius.

The first center found is along the vertical center line and the arc contacts with the extreme top of the triangular figure. The explanation is more involved than the actual construction, which can easily be followed from the diagram and the foregoing text using a pair of compasses. The only variation from the geometrical figures so found is that the recesses in the square figures are paralleled out so that the projections on the inner figure may enter. It will be readily seen that all the curves can be generated with relative ease, and even the variation mentioned presents no particular difficulty.

ROTOR POSITIONS

Taking the illustrations in Figs. 1 to 4, in sequence: in Fig. 1, the space 9 between the two rotors is at the maximum. The inlet port has just closed and the outlet



FIG. 6. PARTS OF A 4-IN. PUMP

port is about to open. The entire cycle of movement and variation of one space can be progressively followed through the four diagrams by the numbers 1 to 16. Starting with maximum volume as 9 in Fig. 1, then going to 10, 11, 12, 13, 14, 15, 16, 1, 2, 3, 4, 5, 6, 7, 8 and 9 completes the progression. The capacity of the pump per revolution is three times the volume of space 9.

The pump consists of an outer casing of cylindrical form having a pair of rotors meshing, the inner rotor being keyed to the driving shaft. These two rotors are set eccentric one to the other, the axial line being at the intersection of the bisection lines at *O* in the geometrical diagram on Fig. 5. The outer rotor has four ports which are open to the chamber of both the suction and discharge side of the pump during rotation. These ports are closed momentarily by a lip at both the top and the bottom of the pump body in order to effect the cut-off between the suction and the discharge of the pump. The liquid is drawn into the pump through the ports of the outer rotor while the pocket is increasing, and forced out at the opposite side of the pump during the last half revolution when the pocket is decreasing.

The rotors themselves are flat acid-resistant castings of suitable thickness, worked on edge to the figures described, their faces being in parallel planes. The outer rotating member is a working fit in the casting at its periphery and is otherwise free, the inner rotor imparting motion to the outer.

The pump is self-priming, easy of installation and can be adapted to almost every pumping condition. Dirt and grit do not seem to affect the pump, inasmuch as there is no rubbing or wearing contact.

Exeter Machine Works, Inc.,
West Pittston, Pa.

Synopsis of Recent Chemical & Metallurgical Literature

Welding Blow-Holes in Steel.—Harry Brearley read a notable paper on this subject before the May meeting of the British Iron and Steel Institute, in which his principal thesis is that the best of welds is never perfect, because the welded surfaces can always be pulled apart, provided the steel is tough naturally, or can be made tough by heat-treatment. Stead's law of welding, "Unless the crystals become common to the two pieces there is no welding," is not rigid on account of the varying amount of interpenetration which may exist, all in apparently good welds, yet all of which can be split apart. Ingots are never quite free from shrinkage cavities, cracks or blow-holes, especially near the axis, and Brearley questions whether these can be welded perfectly—meaning thereby made into metal in all respects as good as any unwelded part of the same piece. In fact, even under most skillful working he feels that such ingot defects are responsible for the "hair-lines" which caused so much trouble during the war in such parts as aero-engine crankshafts. Segregates (especially sulphides) concededly mark their former location; but the trouble lies in the small cavities themselves rather than the sulphide segregate.² In fact, the latter is the telltale witness, in sulphide printing, of the greatest value to metallography, often indicating the pouring temperature, whether top or bottom cast, whether early blow-holes have been subsequently filled by liquid metal, whether axial unsoundness is due to unskillful forging or piped metal; sulphur printing indicates spot segregates on the surface, and "finally it is an indispensable touchstone for the careful steel maker who is making steel for such special purposes as rifle barrels."

As an illustration of the limitations of the present modes of testing welds, several different 3½-in. blooms were drilled axially, a machined 1-in. bar of the same material pressed

¹Jour. Iron & Steel Inst., 1911, vol. 1, p. 54.

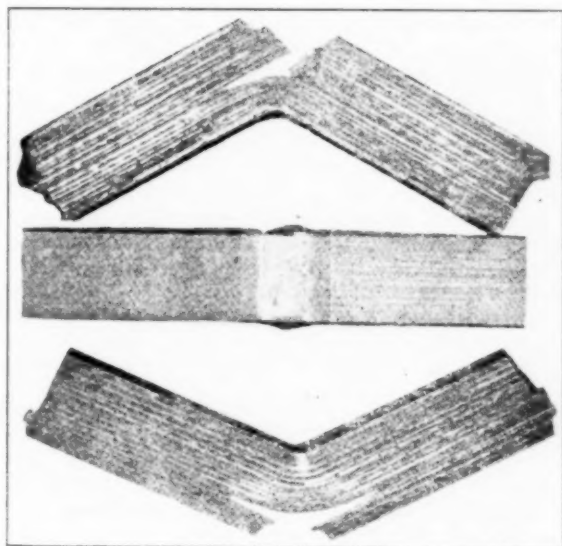
²Dr. Rosenhain, in discussing Stead's paper, said he had some experimental evidence to show that certain impurities, especially soluble impurities, facilitated interpenetration of crystals at surfaces being welded.

in, and welded at the ends, heated and rolled into a bar $\frac{1}{2}$ by $4\frac{1}{2}$ in.

Steel	Microscopic Examination	Nick and Break	Impact on Toughened Bar
0.15 C steel.....	Welded perfectly	Weld split	Weld split
0.35 C steel.....	Welded perfectly	Not split at weld	Weld split
3% Ni steel.....	Welded perfectly	Not split at weld	Weld split
5% Ni casehardening steel.....	Welded perfectly	Weld split	Weld split
31% Ni-Cr steel.....	Welded perfectly	Not split at weld	Weld split

The "nick and break" test must be used with especial caution since it would show the fallacious result that all rolled and forged bars are the better in welding the higher the hardening elements, including phosphorus.

The author proposes a tentative test of weld-ability. Take Izod test-pieces from the sound edge, and the cored middle part of such a bar. The impact strength of the first will represent in great part the force required to propagate the crack already started by the notch. If no weld has occurred in the second bar, the crack will come to a dead stop when it enters the core or leaves it, and a new crack will have to be started in each case, which, as is known, requires proportionally much more energy. A welded bar will have less impact strength across the joint than one which is not so well made. On the other hand, impact strength varies inversely with the hardness, so very hard steels will break through whether properly welded or not. The same is true of all metal having low impact



BROKEN IMPACT PIECES FROM CORED BARS

values. The proposal therefore is to measure the perfection of a weld in terms of the degree of toughness in Izod foot-pounds which must be induced in a steel by quenching and drawing before the weld will be pulled apart in the impact machine, as in the illustration.

On this basis the results of some steels tested are shown below:

Steel	Analysis			Weld-ability	Tension Fracture
	C	Ni	Cr		
A	0.34			28	Cored
B	0.34	3.26	0.28	20	Cored
C	0.32	3.11		18	Normal
D	0.35	3.57	1.05	14	Cored

Under the microscope all the welded surfaces were distinguishable; after annealing all but steel D showed well defined ferrite strings at the former junction, enclosing minute dark spots or threads supposedly of slag.

Even granting that blow-holes cannot be perfectly welded, it would appear that bars made from open steel would be better than from dead-melted under cross-grained impact. Hence the toughness of wrought iron, due to its slag inclusions which would be an unacceptable defect in steel. Hence also the preference for effervescing steel shown by many makers of leaf springs. However, since Brearley's experiments on cored bars, made under the best circumstances as to cleanliness, do not weld perfectly, he concludes that segregates in cavities are not the cause of imperfect welding, nor the cause of transverse weakness in tension.

Recent Chemical & Metallurgical Patents

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Calcium Carbide and Cyanamide.—The heat required for the formation of calcium carbide may be derived from the combustion of an excess of carbon in the charge provided that an oxygen blast is used. Oxygen for this purpose may be available from air separation or reduction apparatus of any well-known type, which will also supply the necessary nitrogen for the conversion of the carbide directly and continuously into cyanamide. Apparatus for accomplishing these results is described by FRED E. NORTON of Worcester, Mass. The charge with its excess of carbon is fed into the top of a vertical retort, the bottom of which is flared into a large chamber. Tuyeres for the introduction of oxygen are situated just above the chamber. Molten carbide which collects in the form of slag in the bottom of the chamber is discharged through a taphole in a continuous stream. If it is desired to make cyanamide, the reaction can be carried continuously as fast as the molten carbide flows out of the furnace, without resort to the heretofore intermediate steps of cooling, pulverizing and reheating the carbide. To this end the spout may discharge the molten substance into a disintegrator consisting of a water-cooled tunnel and a continuous blast of nitrogen from a jet or nozzle. The disintegrated and partly cooled substance passes continuously to a conveyor within a closed nitrogen-filled container in which the cyanamide reaction is completed. (1,374,317; April 12, 1921.)

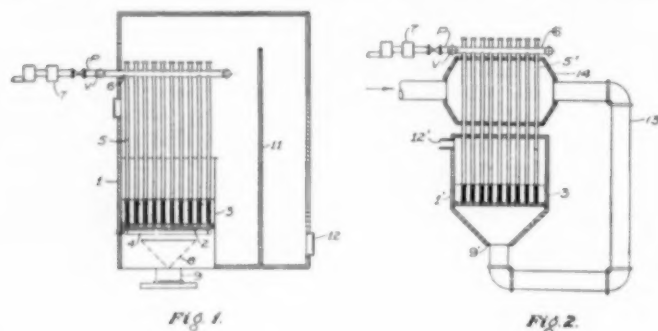
Temperature Control in Production of Anthraquinone by Catalytic Oxidation.—This invention is for a process of producing anthraquinone from anthracene. By this invention use is made of the principle that vaporizable liquids will absorb latent heat in changing from the liquid to the vapor state without change in temperature, the heat being carried away by the vapors from which it may be extracted, thereby condensing the vapors which may be returned for absorbing more heat.

In Fig. 1 the reference character 1 refers to a container which is provided with a perforated plate 2 upon which a layer of catalyst 3 or carrier such as pumice or asbestos for said catalyst is placed. Electrical heating means are shown at 4 and a series of pipes 5 with closed ends extend into the catalyst 3 or the carrier for the same. The upper ends of the pipes 5 terminate in a header 6, which may be connected to a pump 7, which may be used either to create a vacuum or pressure in the pipe or to introduce a gas, preferably neutral, into the header from a source, not shown. A valve V in the pipe P may be closed, if desired, after the pump 7 has been operated to obtain the desired condition in the system. The lower ends of the pipes 5 are filled with a liquid which may be vaporized and then be condensed in the upper end of the tubes 5 and run back into the lower ends. A deflector 8 is shown in the lower part of container 1, which has an inlet 9, and the container 1 is surrounded by a casing or housing 10 having a partition 11 and an outlet 12.

In the modification shown in Fig. 2, the container 1' is provided with an outlet 12', and a pipe 13 leads to the inlet 9' from the jacket 14 which surrounds the upper portion of the tubes 5'. The other parts shown in Fig. 2 are similar to the corresponding parts described in connection with Fig. 1.

The operation according to Fig. 1 is as follows: The reaction mixture is introduced through inlet 9 into container 1, where it comes into contact with the catalyst 3. If necessary, the heater 4 may first bring the temperature up to that required to initiate the catalytic reaction which is an exothermic one. The catalyst 3 becomes heated and the heat is conducted through the walls of the tubes 5 to the liquid

therein, which is caused to boil and the vapors rise in the tubes 5, the upper ends of which are cooled in any convenient way so that the vapors become condensed and trickle back into the lower ends of the tubes 5. The liquid in the tubes is not heated above its boiling point, because an increase in the heat transmitted to the same merely causes an increase in the ebullition without a rise in temperature. The pressure in the system may be increased or diminished by means of the pump 7, thereby varying the temperature



at which the liquid will boil. After the reaction mixture has passed through the catalytic zone, the products of reaction pass upward around the wall 11 and out of the outlet 12, so that the products may be collected and used. The operation according to Fig. 2 is the same as that above described in connection with Fig. 1 except that the reaction mixture is passed through jacket 14 so as to come into contact with the catalyst 3'. The products of reaction pass out through the outlet 12'.

A specific application of this invention is in the oxidation of anthracene to anthraquinone in the presence of vanadium oxide as a catalyzer. It has been found that the proper temperature at which this reaction should be carried out is about 375 deg. C., because very much higher temperatures cause the oxidation to progress too far, and the reaction will not take place satisfactorily at very much lower temperatures. Mercury boils at 357 deg. C., and if a proper pressure is applied upon the mercury its boiling point is changed sufficiently so that if a mixture of an oxygen-containing gas and anthracene in the vapor phase is passed into the catalyst the exothermic reaction to produce anthraquinone will raise the temperature enough to provide sufficient temperature gradient or head between the catalyst 3 and the liquid in tubes 5 when this liquid is mercury so that the exothermic heat is transmitted from the catalyst to the mercury with sufficient rapidity to keep the temperature of the catalyst at about the proper point, or near 375 deg. C. The temperature will be automatically regulated to a certain extent, for when more heat is evolved the mercury will boil more rapidly and thereby remove heat more rapidly. The cooling surfaces of the pipes 5 will be made large enough to assure condensing of all the vapors, and the pressure maintained in the pipes will be such as to keep the boiling point of the liquid mercury so that it will hold the catalyst at the proper temperature. When mercury or other oxidizable liquid is used as the heat-removing agency it may be advisable to introduce into the tubes 5 a neutral gas, such as nitrogen, to prevent oxidation of the liquid. Further examples of chemical reaction to which this invention is applicable are the oxidation of naphthalene to phthalic anhydride, ethyl alcohol to acetaldehyde, and the chlorination of hydrocarbons, etc. (1,347,721; CHARLES R. DOWNS, of Cliffside, N. J., assignor to The Barrett Co.; April 12, 1921.)

Acid-Resisting Articles.—While an alloy of iron and chromium containing certain proportions of iron and chromium carbides is highly resistant to the action of sulphuric acid, such an alloy is brittle and difficult to machine. ALVAH W. CLEMENT, of Cleveland, Ohio, first prepares an alloy of about 60 per cent Cr and 40 per cent Fe under conditions which make the alloy practically carbonless. Articles formed or machined from this alloy are then carbonized to give an acid-resisting surface. (1,375,673; assigned to Cleveland Brass Mfg. Co.; April 26, 1921.)

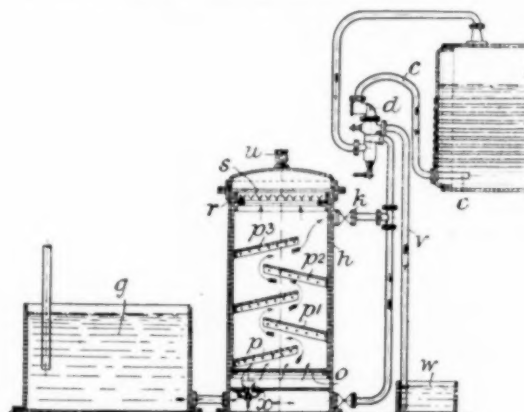
British Patents

For complete specifications of any British patent apply to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Separating Creosote From Tars.—Phenolic bodies are extracted from tars such as lignite, shale, peat, coal, producer and low temperature tars, and from tar distillates and residues and from mineral oils and distillates by washing with a mixture of acetone and water. Acetone extracts of the tars, etc., may be mixed with water or aqueous acetone to cause the separation of the oils, while the creosote remains in solution. (Br. Pat. 156,694; not yet accepted; E. ERDMANN, Halle-on-Salle, Germany. March 16, 1921.)

Zinc White.—Zinc carbonate, oxide and sulphide are prepared from any zinc-containing material by the following reactions. The zinc ore, fume, etc., is first dissolved in acid, preferably hydrochloric, and purified by known means. By passing carbon dioxide in the presence of magnesia or magnesium carbonate into the zinc solution, zinc carbonate is precipitated while magnesium chloride, if hydrochloric acid was used to dissolve the ore, is formed in solution. After filtration and washing, the liquor is concentrated and by the addition of magnesia solid magnesium oxychloride is formed which is readily converted into hydrochloric acid and magnesia for re-use, by heating. Zinc oxide may be obtained from the carbonate by calcination, but preferably by treatment with dilute caustic soda or potash solution which is recovered by means of lime from the resulting alkali carbonate. The precipitated zinc oxide is removed and dried and the solution made by dissolving it in acetic acid or dilute mineral acid is used to prepare zinc sulphide. After the precipitation and removal of the latter, the liquor is used again by redissolving a further quantity of zinc oxide or carbonate and reprecipitating as sulphide. Alternatively the sulphide is prepared by passing sulphuretted hydrogen into a closed mixing device containing a suspension of excess of zinc carbonate in water, or in a dilute solution of hydrochloric acid or zinc salt. Sulphuric acid may be used in the place of hydrochloric for dissolving the ore, but the latter is preferred since it enables the magnesia and acid to be recovered readily. (Br. Pat. 157,860; not yet accepted; C. CLERC and A. NIHOUL, Paris. April 6, 1921.)

Separating Air From Feed Water.—Apparatus of the character described in the parent specification for separating gases from liquids is arranged on the suction side of the water feed to steam-generators. The air-removing



chamber *h* is supplied with water from the tank *g* through the valve *x*, and the purified water is drawn off through the outlet *k* by the injector *d* and forced through the pipe *c* into the boiler. The overflow pipe *v* dips into a reservoir *w*. The air-removing chamber *h* is constructed with a perforated plate *o*, alternating inclined shelves *p*, *p*¹, *p*², *p*³ supporting the turnings, shavings, fibrous material, or other substance for causing the air to separate, and with a series of angle-bars *s* supported on an angle-ring *r* which form a kind of partition between the purified water and the uppermost layer of water which is in contact with the separated air at the top of the chamber. (Br. Pat. 157,790; not yet accepted; C. HULSMAYER, Düsseldorf. April 6, 1921.)

Treating Tin-Bearing Tailings.—Tin-bearing rocks having a small content of stannic oxide, or "tailings" left after the mechanical separation of stannic oxide, are reduced by suitable gases, and the resulting metallic tin associated with a large quantity of gangue subjected to the action of anhydrous chlorine.

The reaction vessel is provided with a jacket through which a cooling medium may be circulated in order to maintain approximately atmospheric temperature. The stannic chloride thus produced is separated by leaching with a solvent such as warm water or caustic soda solution, by distillation preferably at reduced pressure, or by blowing hot air on the heated mass. The volatilized stannic chloride is condensed in water and the hydrated chloride used to prepare other tin salts or metallic tin. The latter is extracted by passing the solution of stannic chloride into a series of boxes each containing zinc turnings; spongy tin is precipitated, while zinc chloride free from tin collects in the last box. The addition of a small amount of stannic chloride is found to facilitate the commencement of the reaction between the metallic tin and the chlorine, and if the ore contains arsenic or sulphur these are removed by roasting before the reduction of the stannic oxide. (Br. Pat. 159,071; J. J. COLLINS, Winsford, Cheshire. April 27, 1921.)

Book Reviews

RESEARCH AND METHODS OF ANALYSIS OF IRON AND STEEL (Second Edition). Pp. 220. By Research Department of the American Rolling Mill Co., Middletown, Ohio, 1920. Price \$4.

This book is a publication of the control practice, along physical and chemical lines, adopted by the well-equipped laboratory of a modern rolling mill producing a specialized product—ingot iron. In addition, chemical methods used by this company in research and investigative work are also described, such as for the determination of the gaseous constituents of iron and steel. Following the introduction and a short chapter given to Ancient Irons and Modern Research, the book is divisioned accordingly: Research on Corrosion; Magnetic Testing; Metallurgical Control; and Chemical Analysis; with subsequent pages including Useful Data and the Index.

The dissertation on research on corrosion is devoted exclusively to the possible or probable effects that gaseous impurities in ferrous metals have on their corrosion. One is first acquainted with the respective works of Miller and Austin relative to the considerable quantities of occluded gases found in both liquid and solid steel, and also with the beneficial results obtained in the physical properties of a steel degasified by vacuum treatment. From these observations arise a conception that possibly the gaseous constituents of steel may have a considerable bearing on its life under corrosive conditions. The results of investigations by the research department on the gas content of materials showing good and poor corrosion resistance are then given, with the fact stressed that in all cases the nitrogen content is higher in the rapidly failing steels than in those that are more resistant. Throughout this chapter are presented photographs of old iron and modern steel fabrications, showing respectively excellent and poor states of preservation after service.

Under Magnetic Testing the description of necessary apparatus and procedure for testing the magnetic properties of steel and iron is essentially the same as found in the standards of one of our national societies. The heading Metallurgical Control covers principally a description of the equipment used by the American Rolling Mill Co. for the pyrometric, metallographic and physical control of its output during and at completion of production, with a general outline of the work entailed in the mill and laboratory. More than half of the volume is devoted to Chemical Analysis, where are given in alphabetical sequence methods for the determination of all elements, common and rare, encountered as impurities in iron and steel.

This includes the gaseous elements, hydrogen, oxygen, nitrogen (as nitride), and also the compound carbon monoxide. Considerable space is allotted to different procedures for carbon, with the inclusion of a detailed description of the gasometric method devised and used by T. D. Yensen for the separate determination of the different forms of carbon in iron—viz., gaseous and solid. Besides the procedures for determining the constituents occurring in iron and steel, complete instructions are given for the evaluation of the metallic coatings commonly applied to ferrous products. Details are presented regarding the selection of samples, with particular reference to sheets. A description of Dr. A. S. Cushman's new method for determining the weight of spelter coating by measuring the hydrogen evolved brings up to date this branch of testing.

Taken as a whole, the book can scarcely be recommended as a general text for the iron and steel chemist or metallurgist. While true to the title, in that methods are given for the determination of practically every constituent encountered in iron, in many cases valuable details or notes are lacking, a fact at least partly recognized by the authors, who state in the preface, "Where well-known methods have been described, we have omitted details which are well understood by the skilled chemist. Where new methods are described, we have entered into minute details." Therefore the value of the book revolves largely about the call the user has for these uncommon procedures. As the treatise Research on Corrosion deals only with the rôle that may be played by gaseous inclusions in iron or steel and no mention is made of those constituents whose presence in ferrous metals has been more or less generally recognized as inhibiting corrosion, the non-inclusion of these types in the data exhibited militates seriously against the significance that might otherwise attach to the interesting findings here presented.

This handsomely finished little volume is palpably a medium of publicity; however, since it contains some uncommon technical data of value and a contribution of new thoughts and work, it has a certain value in the library of those interested in iron and steel.

R. H. NEALE.

* * *

PYROMETRIC PRACTICE; Technologic Paper 170, Bureau of Standards. By Paul D. Foote, C. O. Fairchild and T. R. Harrison. 326 pages, 7 in. x 10 in. Price, 60c., from the Superintendent of Documents, Government Printing Office.

Pyrometric practice has become so widespread in recent years that a real need has been felt for a supplement to the standard work of Burgess and LeChatelier on "Measurement of High Temperatures," describing the many successful instruments which have been recently marketed. It is only fitting that such a book should come from men attached to Dr. Burgess' division of the Bureau of Standards, men who have had every opportunity to compare the various types and who have already written much helpful information on various phases of this subject in technical journals and society proceedings.

The Burgess-LeChatelier work is indispensable for its treatment of fundamentals; indeed there seem to be no instruments described in "Pyrometric Practice" which are not directly traceable to the types discussed in the older book. However, the new publication illustrates the large number of available pyrometers, indicators, recorders and fittings by photographs and diagrams of actual instruments or installations, whereas the sketches as well as the discussions in the older book are more of ideals.

In recent years there has come into being a type of metallurgist who must know about temperature control of industrial operations; some men are so specialized that the care of pyrometer installations occupies their whole time. All such will welcome the new book, and find in it a clear, unbiased description of practically every type of temperature-measuring device now on the market, invaluable information on the proper installation and use of all this various equipment, and a large number of helps in keeping it operating correctly. Burgess and LeChatelier and Foote, Fairchild and Harrison will be the pyrometricians' Old and New Testaments.

E. E. THUM.

Current Events

in the Chemical and Metallurgical Industries

Hotel Accommodations for Fall Meeting, A. C. S.

Hotel headquarters for the meeting of the American Chemical Society in New York City, Sept. 6-10, 1921, will be at the Waldorf-Astoria Hotel, Fifth Ave. and Thirty-third St. Through the courtesy and co-operation of the Hotel Association of New York City the committee has arranged to receive applications and make reservations at the various hotels throughout the city. Applications should be made promptly, and it is suggested that two or more persons take advantage of double rooms and suites wherever possible. Prices at the various hotels range from \$1.50 to \$5 per day for single rooms and from \$3 to \$10 for double rooms.

Columbia University has offered the facilities of its dormitories to aid in meeting the requirements of those desiring to attend the meeting. Rooms for men, rooms for women and rooms for married couples have been reserved in the dormitories at the rate of \$1.50 per day per person, with a maximum per person of \$10 for the period Sept. 6 to 16, for those wishing to stay for the Chemical Exposition.

Applications, giving the following information, should be forwarded as soon as possible to Charles F. Lindsay, chairman of the hotels committee, c/o United States Rubber Co., 1790 Broadway, New York City:

- Application for.....persons.
- Names of those in party.
- Type of reservation desired.
- Maximum price per day per person.
- Time of arrival.
- Expected departure.

Reservations will be confirmed from the designated hotels.

Young Opposes Longworth Resolution

The only Republican member of the Committee on Ways and Means of the House of Representatives who objected to the Longworth resolution, which has as its object the placing in immediate effect the duties carried in the forthcoming tariff bill, was Representative Young of North Dakota. He did not submit a minority report, but in a statement he takes the position that such legislation would be unconstitutional. He says that the decisions of the United States Supreme Court always have been that Congress cannot delegate legislative authority. Representative Young contends that it will require a faith in the Ways and Means Committee nothing short of sublime to give rates of duty force of law before those rates are known to members of Congress. He points out that the agitation of the question is likely to result in waste of time. He doubts if the resolution will pass the House and he feels very certain that the Senate will not abdicate and calmly allow a general tariff bill to become a law for a period of five months without its having been considered by the upper house. He also doubts if the President will tie his own hands in matters not only affecting economic considerations but possible complications with foreign countries.

Representative Young contends that the proposed action does not have a parallel in the somewhat similar procedure of certain foreign governments. "The government" in those countries, he points out, holds office at the pleasure of the popularly elected branch of the legislature and can be voted out of office promptly if it reports customs rates or provisions which are unsatisfactory. The government or ministry in these foreign countries, Mr. Young points out, is charged with executive functions and responsibilities, whereas the Ways and Means Committee has no such responsibility.

Final Program, American Leather Chemists Association Meeting

The eighteenth annual meeting of the American Leather Chemists Association will be held at the Hotel Ambassador, Atlantic City, June 9, 10 and 11. Morning sessions will convene at 10 o'clock, afternoon sessions at 2 o'clock.

THURSDAY MORNING, JUNE 9

- Opening remarks by the president, F. H. Small.
- Report of secretary-treasurer, H. C. Reed.
- The Effect of Atmospheric Humidity on the Determination of Moisture in Leather, T. D. Jarrell.
- Committee report: Determination of Epsom Salts in Leather, R. W. Frey.
- Committee report: Determination of the Sugar Content of Leather, J. S. Rogers.

THURSDAY AFTERNOON, JUNE 9

- Relation of South America to the Leather Industry, G. A. Kerr.
- Committee report: Sampling and Preparation of Leather for Analysis, F. H. Small.
- Soaking and Liming Hides, C. M. Morrison.
- Some Applications of Synthetic Tanning Extracts, J. B. Hill and G. W. Merryman.
- Some Effects of Post-Mortem Changes in Fresh Hides, G. D. McLaughlin.
- Demonstration of the Explosiveness of Tannery Dusts, R. W. Frey.

FRIDAY MORNING, JUNE 10

- Committee report: The Determination in Leather of Matter Extractable by Water, J. A. Wilson.
- Notes on the Extraction of Leather, F. P. Veitch and R. W. Frey.
- Further Observations on the Wilson-Kern Method of Tanning Analysis, G. W. Schultz.
- Committee report: The Direct Measurement of the Plumming Power of Tan Liquors by the Clafin Method, A. A. Clafin.
- Rapid Washing of Chromed Hide Powder, R. W. Frey and I. D. Clarke.

FRIDAY AFTERNOON, JUNE 10

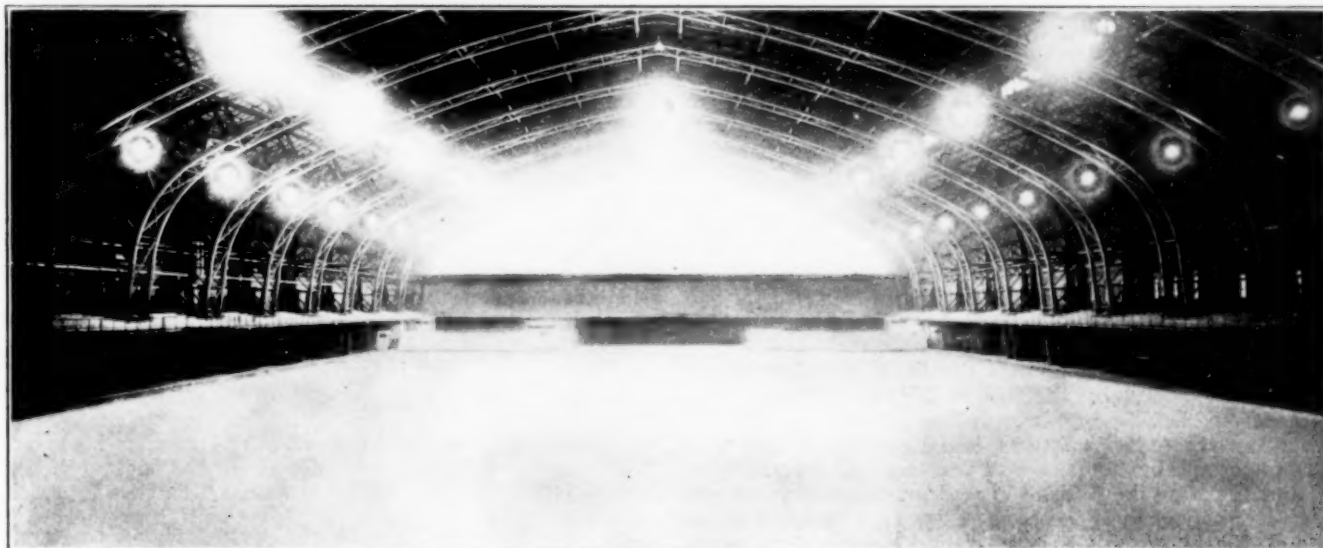
- Chestnut Wood Tanning, R. W. Griffith.
- Colloids, H. N. Holmes.
- Conditions in the Leather Industry, L. J. Robertson.
- Tanning Materials in the Far East, L. Balderston.
- Determination of Available Calcium Oxide in Lime Used for Unhairing Hides, F. P. Veitch and T. D. Jarrell.

SATURDAY MORNING, JUNE 11

- Committee report: The Color Measurement of Vegetable Tanning Solutions, T. Blackadder.
- Committee report: Estimation of Oils and Greases in Leather, F. P. Veitch.
- Executive session.
- Election of officers.
- Council meeting.

Research Chemicals Committee Named

The National Research Council has approved the appointment of a committee to prepare a list of research chemicals. The membership of the committee is as follows: W. D. Collins, chairman; Roger Adams, Captain D. B. Bradner, H. T. Clarke, W. F. Hillebrand, George C. Spencer and Clarence J. West. This committee will prepare a list of sources of various materials not commonly available, particularly those needed for special researches.



INTERIOR EIGHTH COAST ARTILLERY ARMORY

Seventh National Exposition of Chemical Industries

Announcement has just been made that the Seventh National Exposition of Chemical Industries will be held in the Eighth Coast Artillery Armory, Jerome Ave. and Kingsbridge Road, New York City, during the week beginning Sept. 12. Some idea of the facilities available may be obtained from the accompanying illustration showing the drill floor of the armory. There will be ample room for the 400 or more exhibits on this floor, which, it will be noted, is entirely free from obstructing posts and pillars. The armory is readily accessible from all parts of the city, the running time from Grand Central by way of the Jerome Ave. extension of the Lexington Ave. subway being about 30 minutes. It is also provided with an auditorium in which the symposiums and exhibitions of motion pictures will be held and with a dining room that will accommodate 1,400 persons.

During the week preceding the Exposition, chemists and chemical engineers from all parts of this country and from abroad will gather in New York for the joint meeting of the Society of Chemical Industry and the American Chemical Society. Those present at this meeting will thus be able to attend the Exposition as well.

Dr. Charles H. Herty, editor of the *Journal of Industrial and Engineering Chemistry*, is chairman of the advisory committee in charge of the 1921 Exposition. Others on this board include Raymond F. Bacon, director, Mellon Institute; L. H. Baekeland, honorary professor chemical engineering, Columbia University; Henry B. Faber, consulting chemist; John E. Teeple, president, the Chemists Club; Bernhard C. Hesse, chemist, General Chemical Co.; Acheson Smith, president, American Electrochemical Society; A. D. Little, president, Arthur D. Little, Inc.; William H. Nichols, chairman of the board, General Chemical Co.; H. C. Parmelee, editor, *CHEMICAL & METALLURGICAL ENGINEERING*; Fred W. Payne, co-manager of the Exposition; R. P. Perry, vice-president, The Barrett Co.; Charles F. Roth, co-manager of the Exposition; Edgar F. Smith, president, American Chemical Society; T. B. Wagner, vice-president, U. S. Food Products Corporation; David Wesson, president, American Institute of Chemical Engineers, and M. C. Whitaker, president, United States Industrial Chemical Co. The headquarters of the Exposition are now located at 342 Madison Ave., New York City.

Helium Repurification

The U. S. Bureau of Mines has undertaken to complete the installation of apparatus for the repurification of helium at the Langley Field plant. The work is being done in co-operation with the Army and is under the general direction of Dr. R. B. Moore, chief chemist of the Bureau of Mines. D. M. Ferris is the engineer in immediate charge.

Bureau of Mines Technical Motion Pictures

Motion pictures of ingot iron manufacture and of sulphur production formed the program of the 320th meeting of the Chemical Society of Washington on May 25. These films were furnished by the Bureau of Mines, which has a long list of such technical motion pictures for distribution. Any society or local section desiring the use of this sort of an entertainment should apply to T. T. Read, Division of Education and Publications, Bureau of Mines, Washington. There is no charge made by the bureau for this use of the various pictures which have been prepared in co-operation with the industry.

American Society of Mechanical Engineers Spring Meeting

The spring meeting of the American Society of Mechanical Engineers convened at the Congress Hotel, Chicago, Ill., May 23-26. A large attendance held a number of activities which were of direct interest to operators and owners in the chemically-controlled industries. Some of the papers presented are briefly abstracted in the following report.

FUEL SESSION

E. G. Bailey in an exhaustive paper on recording ash-pit loss from chain-grate stokers gave data obtained from a recently-developed device which enables firemen to effectively control this factor. The device in the main consists of a steel tube or bulb filled with nitrogen and connected through a capillary tube to a recorder consisting of a mercury U-tube, one leg of which is open to the atmosphere and carrying a float to which the recorder pen is attached. It has been found that when this bulb is properly located near the rear of a chain-grate stoker, its temperature will respond definitely to changes in the amount of combustible matter going to the ash-pit and will vary in direct proportion to the heat thus lost. This relation between temperature and ash-pit loss is not materially affected by grate feed, rate of combustion or percentage of ash in coal, but should be determined for different types of installations by actual tests.

Recording instruments have been devised which show on the same chart the ash-pit loss, excess air, unburned gas, flue-gas temperature and steam flow. The records thus obtained make it possible to plot characteristic performance curves for stokers showing the losses due to unburned combustible, unburned gases and excess air, and to determine the proper amount of excess air to be maintained and also the most efficient capacity. These curves can be used to compare the relative efficiencies of different types of stokers, the suitability of different kinds of coal, and the effectiveness of the control by the fireman.

Henry Kreisinger and John Blizard presented a summary of the results obtained in an extended series of tests on a

468-hp. water-tube boiler fired with pulverized Illinois coal which showed that contrary to the customary specifications it is not necessary to pulverize the coal to the extreme fineness of 85 per cent through a 200-mesh screen in order to get good combustion and good efficiency. This ability to burn coarser coal means increased capacity of the pulverizing mills and decreased cost of coal preparation. The results also show that it is not necessary to dry coal to about 1 per cent moisture in order to burn it successfully in pulverized form and it is stated that with most Eastern coals drying is not at all necessary. Good results can be obtained when the coal is burned at rates varying from 0.5 lb. to 2 lb. per cu.ft. of combustion space per hour, and the best results at a rate of 1 to 1.5 lb.

Edward H. Tenney discussed the limitations imposed on mechanical stokers by the use of Mid-West coals, which are characterized by higher moisture, volatile and ash contents as compared with Eastern coals; the limits imposed by air supply and by the design of the furnace; and the effect of these various limitations on stoker operation. In general the application of mechanical stoking equipment to the use of Mid-West coals has proved to be eminently successful. Specially designed arrangements for air supply and to facilitate ignition of the fuel have been provided, and furnace volumes and gas passes have been scientifically studied, with the result that the most difficult problems—namely, those incident to operation at high rates of combustion—have been satisfactorily solved.

John E. Wilson, of Swift & Co., in speaking of capacity and efficiency limitations of stokers using Mid-West coals, said that less progress had been made in the direction of securing efficient combustion than in any other direction immediately connected with stoker service. In the case of natural draft chain-grate stokers the greatest losses are those due to the dry chimney gases and carbon in the ash, and the possibility of making a material gain in the efficiency lies to a great extent in ability to reduce these two losses. A certain amount of air admitted over the fire has been found advantageous when high volatile coals are used, such as those found in the Middle West. Chain-grate stokers provided with forced draft operate successfully under continuous high rating, respond quickly to load requirements and will successfully burn coal containing a large percentage of ash which fuses at a comparatively low temperature.

Underfeed forced-draft stokers in the Mid-West district have a large number of very satisfactory operating records to their credit both from an efficiency and a capacity standpoint. Some types of overfeed stokers have also been used with success in this section where only a limited capacity was required and suitable coal was available. The necessity of securing improved refractories as well as improving the furnace design is emphasized by the difficulties encountered with the brickwork when forced-firing is employed, and it is possible that these may prove factors governing the capacity which will be obtained in future installations.

A paper by Frank Chambers on the "Latest Requirements of Chicago in Furnace Design" with special reference to hand-fired boilers was presented in abstract by Robert Kuss. It contained some data on draft drop through the setting and in the gas passages, velocity of gas flow, area and height of stack, city requirements and typical designs of furnace.

GENERAL SESSION

Snowden B. Redfield described some capacity tests of dry vacuum pumps by the low-pressure nozzle. A nozzle was used in which the downstream or back pressure is higher than the critical. This permitted the determination of several values of volumetric efficiency over a range of vacua without changing the nozzle. Graphic proofs of the accuracy of the theory of the nozzle were presented, showing clearly that the method of plotting results permits ready estimation of approximate performance of any given pump.

Magnus W. Alexander and Dugald C. Jackson, in a paper on "The Engineering Industries and Engineering Education," stated that a combination of empiricism and training in rational science is needed in engineering education, because it is needed in the engineering industries. This consideration has led to various plans for placing engineering stu-

dents within the influence of industrial operation, the most common being for engineering college graduates to enter industrial establishments as engineering apprentices or student engineers. The plans put into effect at the Massachusetts Institute of Technology and the University of Cincinnati were outlined. It is believed that these experiments in co-operative engineering training will exert a most beneficial influence upon the relation of the engineering college to industry upon the activities of each. While co-operative training in engineering cannot replace the regular engineering courses at colleges, it is nevertheless destined to become a vital integral part of a comprehensive system of engineering education to the detriment of none of the other parts, but to the mutual benefit of all, and is particularly important to the manufacturing industries of the nation.

R. S. Johnston, of the Bureau of Mines, Washington, reported the results and conclusions from an elaborate series of tests on oxy-acetylene welding and cutting blowpipes. This paper, without doubt, described the most complete series of tests on oxy-acetylene welding that has ever been published. The general conclusions were that there is a great deal of difference between the characteristics of different designs of cutting blowpipe and that there is no make of apparatus which is equally efficient and economical for all thicknesses of metal.

J. R. McDermet, in a discussion on the "Interpretation of Boiler-Water Analyses," emphasized the importance of taking into consideration the corrosive properties of a boiler-feed water as well as its scale-forming tendencies. Feed-water impurities fall into at least one of three groupings: dissolved solids, pollution products, and dissolved gases. The dissolved products determinable under a technical analysis naturally group themselves into corrosive and scale-forming constituents according as they are or are not highly ionized in aqueous solutions. Pollution products are detected by inferential methods in a partial sanitary analysis, but the effects of various types of pollution other than manufacturing wastes as indicated by the analysis are concretely set forth. Dissolved-gas analyses (meaning in the main dissolved-oxygen analyses) were discussed in relation to the safe operating limits of hot-water feed lines, boilers, and cast-iron steel-tube economizers.

An appendix to this paper translates the facts into a working plan for use in the chemical laboratory.

POWER SESSION

Samuel Insull, presiding officer, opened the power session with the remark that it took a great war and a British commission to convince this country that concentration in the production of electrical energy was an economic gain. Superpower plan proposed for the East was good and well worth considering, but if engineers in general would pay more attention to the forwarding of similar projects in their respective localities their efforts would be more effective. In the Mississippi Valley there are few locations where large plants can be located at the mouth of the coal mine due to the lack of water, and they must therefore be placed at the centers of distribution with no waste or duplication, each serving the surrounding territory and all tied together with a network of transmission lines. This can be done economically. Prominent factors, then, in this territory where relatively small water power is available, are cheap transportation and ample water facilities for cooling and boiler-feed water.

W. L. Abbott, in discussing the location and distribution of central station power in the Middle West, stated that this section of the country contained only 18 per cent, or 776,000 kw., of the water power of the United States, the greater part of this lying in the States of Michigan, Wisconsin and Minnesota. Ohio, Indiana and Illinois, which are the richest in coal, are poorest in water power. It is cheapest to ship coal by rail to plants advantageously located than to generate at the mouth of the mine and have a standby station in the city with a transmission line between, this being true even with the excessive and unequal freight rates now in force.

C. W. Place, speaking of the future power developments in the Middle West, pointed out that in this territory large centers of generation have been developed, but they are

far apart, and each has its tributary country of low load density made up of towns and villages with farming country drained by innumerable streams that should supply power to the towns and villages near them. In the fourteen central states there are 102 cities of over 25,000 people each with a fairly efficient steam plant. It is proposed that the power houses of these cities be connected together not by heavy high-voltage lines, but by lines which will pick up the small town and village loads to the point where its next large neighbor would take its share. Hydro-electric plants along these lines would be automatically connected in.

BUSINESS SESSION

The following nominations were announced for officers of the society: President, Dexter S. Kimball; vice-presidents, Colonel E. A. Deeds, Robert Sibley, L. E. Strothman; managers, Sherwood F. Jeter, Horace P. Liversidge; treasurer, William H. Wiley. Members of American Engineering Council, Francis Closson, Charles A. Booth, Gano Dunn, H. H. Esselstyn, W. S. Lee, Irving E. Moulthrop, John A. Stevens, A. E. Walden and Perley F. Walker. Atlanta, Ga., was named as the place at which the next spring meeting would be held.

Subjects for Papers Before the American Society for Steel Treating

Prof. H. L. Campbell, Ann Arbor, Mich., has been appointed chairman of the meetings and papers committee of the American Society for Steel Treating. Associated with Prof. Campbell on this committee are: George O. Desautels, president of the Imperial Drop Forge Co., Indianapolis, Ind., and Victor Hillman, metallurgist, Crompton & Knowles Loom Works, Worcester, Mass.

The board of directors has authorized the awarding of a gold medal for the best paper presented at the Indianapolis convention and a silver medal for the second best paper. While the awarding of these medals for this year has been made to apply to those papers presented for this year's convention, the policy in future will be to award the medals to the first and second best papers presented before the society during the year.

A list of subjects upon which papers will be presented follows:

GENERAL TOPICS

1. The Organization and Management of a Heat-Treating Department.
2. Practice of Handling and Checking Materials to and From Heat-Treating Department.
3. Quantity Production Methods for Forging and Heat-Treating Tools.
4. Methods for Heat-Treatment of Very Small Machine Parts.
5. Heat-Treatment of Sheet Steel Parts as Saws, Hack Saw Blades, etc.
6. The Artificial Seasoning of Hardened Steel.
7. Furnace Design With Reference to Fuel Economy.
8. Metallography and Its Application.
9. Comparative Study of Methods for Heating Furnaces by (a) Coal, (b) Fuel Oil, (c) Gas, (d) Electricity.

ALLOY STEELS

1. Topical Discussion of Alloy Steels and Their Heat-Treatments for Specific Purposes; as (a) Springs, (b) Gears, (c) Finishing Tools, (d) High-Speed Cutting Tools, (e) Dies.
2. Practice of Ordering Tool Steel on Specifications.
3. Cutting Efficiency of High-Speed Steel Which Has Received Different Methods of Hardening.
4. Die Blocks and Their Heat-Treatment.

CARBURIZING

1. Carburizing Practice Adapted to Alloy Steel Parts.
2. Determination of Unit Cost of Carburizing Steel Parts.
3. Efficiencies of Different Mixtures for Cyanide Hardening.
4. Practice of Cyanide Hardening.
5. The Service of Annealing Boxes Made of Different Materials.

Personal

C. L. BRYDEN, chief engineer for the Kelly Filter Press Co., New York City, has associated himself with W. P. Heineken, engineer and manufacturer, New York City.

PAUL H. HSU, a graduate of the Massachusetts Institute of Technology and formerly research chemist with the Larkin Co., Buffalo, N. Y., and the chemical division of the Procter & Gamble Co., Cincinnati, Ohio, is now on his way to China, where he expects to engage in consulting work and marketing of chemical machinery and materials.

Dr. R. B. MOORE, chief chemist of the Bureau of Mines, delivered the Sigma Xi lecture at the University of North Carolina on June 3. His subject was "Helium."

O. C. RALSTON has been named assistant chief metallurgist by the Bureau of Mines. His appointment will become effective July 1. His headquarters will be at Berkeley, Cal., where he also will have charge of the work at the Berkeley station. He will direct all the work of the bureau on non-ferrous metals. Since Jan. 1 Mr. Ralston has been superintendent of the Seattle Experiment Station.

Dr. R. E. ROSE, of the chemical division of the du Pont Co. has been transferred to the dyestuff division, as assistant director of the technical laboratory.

JOHN J. RUTLEDGE has been transferred from station superintendent at St. Louis to the position of superintendent of the Urbana Experiment Station. G. J. Salmon has been designated to be acting superintendent at St. Louis.

O. V. URBAN took charge of the chemical work of the Guttenberg refinery of the American Cotton Oil Co. on June 1.

E. R. WILES has resigned his position as chief chemist of the Southern Oil Corporation to assume the position of chief chemist with the Barnsdall Refining Co., Bigheart, Okla.

J. C. WITT of the Structural Materials Research Laboratory, Chicago, recently returned from an inspection trip to the arid regions of Colorado, in connection with research on the effect of alkali on concrete.

Obituary

FRANK D. BAKER, for twenty years chief engineer for the Colorado department of the American Smelting & Refining Co., died in Denver on April 29, at the age of sixty-three, following an operation for ulcer of the stomach. During his long service with the smelter company Mr. Baker was in charge of or intimately connected with much of the metallurgical plant construction in the state, and was widely known and admired by Western metallurgical and mechanical engineers. He was the inventor of numerous metallurgical devices, of which the best known is the Baker cooler, for cooling calcined materials on a large scale. Mr. Baker was graduated in 1888 from the course in mechanical engineering at the University of Illinois. He was a member of the American Society of Mechanical Engineers and the Colorado Society of Engineers. He is survived by his wife and five children.

Colonel THOMAS CURTIS CLARKE of New York City, a metallurgical and civil engineer, died suddenly May 26 at the Roosevelt Hospital, of pneumonia following an operation. Colonel Clarke had engineering charge of special work for the Illinois Steel Co., was formerly general superintendent of the Lackawanna Iron & Steel Co., supervising engineer of the Deutsche Bank of Berlin and was a consulting engineer, located in New York City, specializing in coal and coke and its byproducts until the entry of the United States into the war. He served in the A. E. F. as Colonel of the 110th Engineers, 35th Division.

Current Market Reports

The Chemical and Allied Industrial Markets

NEW YORK, June 6, 1921.

Trade conditions have been decidedly better in the chemical market, even though the week-end holiday intervened. Business has been going along in extremely good fashion and interest from consumers seems to be growing. The strengthening of the resale market for alkalis is probably the most hopeful sign in the market. Although alkalis are being imported in good-sized quantities, the demand has increased to such an extent that prices on the spot are noticeably firming up. All general indications point to a steady improvement with the present market as a basis. The most important occurrence of the week was the pronounced advance of *caustic soda* and *soda ash* with higher prices asked despite offers from abroad of large quantities. The market on caustic opened at \$3.85 per 100 lb., and at the close there was enough odd lot buying to lift prices up to 4c. per lb. Along with these two leading chemicals has been a stronger market for *bichromate of soda* and *potash*, *prussiate of soda* and other items of varying importance. On the other hand, some chemicals have remained in a somewhat dormant position, with consumers still following the hand-to-mouth buying policy. Signs of improvement are apparent in many of the more important industries and it must be admitted that while there is a certain amount of this improvement taking place in basic conditions, buying confidence has been so badly shattered during the recent business depression that expansion can be along gradual lines only. Sellers feel encouraged that the long period of hand-to-mouth buying is visibly dwindling away and that shelves among the consuming element are well cleared. The tendency among leading industrial plants is to increase capacity. Soap factories are buying in freer style and glass-makers seem to be working toward a more normal output. Paper mills and tanneries are still lagging behind in production.

CHEMICALS

Resale lots of domestic *chlorate of potash* were quoted by second hands at 8½@9½c. per lb., according to seller. Prime domestic material is quoted by producers at the former price of 12c. per lb., f.o.b. works. German shipments were quoted at 8½c. per lb. The *muratic acid* situation is extremely sluggish, with consumers contenting themselves with only minimum quantities. Makers are still holding prices at the former levels, as it is expected that consumers will sooner or later come into the market for more normal requirements. The present basis is quite close to the cost of production. Quotations on the 20 deg. are based on \$1.50@\$1.75 per 100 lb. Prices on *sulphuric acid* remained unchanged at recent levels, with the demand very light. Quotations on 60 deg. acid in tank cars f.o.b. works are around \$11@\$13 per ton. The 66 deg. strength is quoted at \$18@\$20 per ton. Demand for *oleum* has been very slow, with quoted prices for the 20 per cent in tank cars at \$23@\$25 per ton. Consumers are showing very little interest in this item. Makers of *aluminum sulphate* are quoting the iron free at \$3 per 100 lb. in the face of a very slow demand. The commercial grade could be obtained all the way down to \$1.75 per 100 lb. The market on *ammonium sulphate* continues very dull, with stocks heavy and only a few buyers in the market. Prices are subject to shading on any firm business. The spot price is around \$2.75 per 100 lb. *Bleaching powder* is very sluggish, with resale material offered at \$2.15 per 100 lb. f.o.b. works. Makers are still holding their prices around \$2.75 per 100 lb. There were only a very small number of buyers during the week. Resale lots of *carbon bisulphide* were offered on the spot down to 6c. per lb., against a producers' price of 8c. The manufacturers were given the preference, however, as resale stocks at low figures are of a limited nature. Prices on *caustic potash* remained with-

out any quotable change at former levels. The demand has been very slow. Resale caustic of American manufacture is offered around 5½c. per lb. German caustic is held at 6½@7½c. per lb. on spot.

Yellow prussiate of soda appeared firm, and dealers reported sales at 12½c. per lb. ex-store. Shipments are offered at 12½c. per lb. N. Y. Spot material is not so plentiful at the moment and several large sellers quote 12½@13c. per lb., according to quantity. Dealers of *bichromate of soda* are not willing to quote below 8c. per lb. for standard brand material and in some quarters 8½c. is being asked. A scarcity of round lot offerings is holding the market in a firm position. Resale solid *caustic soda* reached 4c. per lb. in the late trading on all standard brands. Sales were made earlier in the week at \$3.85@\$3.95 per 100 lb., and it was reported that some large tonnages were closed at the inside figure. Those close to the pulse of trading stated that shelves have been well cleared of resale material and some of the large dealers admitted that their surplus has been exhausted. The final offering was firm with 4c. per lb. quoted for limited quantities.

Resale light *soda ash* in single bags continued to be in limited supply on spot and dealers are holding the market at \$2.20@\$2.25 per 100 lb. At the works it was stated that small quantities of resale stock could be purchased at \$1.90@\$2 per 100 lb. Small lots of ash in barrels are moving at 2½c. per lb. ex-store N. Y., while at the works limited quantities were quoted by second hands at 2½c. per lb. Producers quote \$1.65 per 100 lb., basis 48 per cent, in single bags and 2c. per lb. in barrels, basis 48 per cent. Special quotations are being made for contracts, the price varying according to quantity. Prices on *carbonate of potash* are still very uncertain, with supplies rather heavy. It is possible to shade any quoted figures on either the 80-85 per cent or the 96-98 per cent material on the spot market. Quotations on the former grade are around 6c. per lb. and on the latter about 9c. per lb. The announcement of the passage of the emergency tariff measure has so far had no pronounced effect on *nitrite of soda*. Prices are around 7½@8c. per lb., although some factors are quoting as high as 10c. per lb. The prospect of the inclusion of a 2c. duty on nitrite in the permanent tariff will undoubtedly have a better effect than the present measure. Sales of *formaldehyde* are reported at 14½@14¾c. per lb. in barrels on spot. The call is limited mostly to small lots, while in general a rather satisfactory amount of business is reported.

Considerable business of small lot nature is passing in *oxalic acid* at prices ranging from 16½@18c. per lb. Some sellers are not meeting these figures, but others state they are in a position to fill inquiries and say the demand is rapidly increasing.

The consuming demand for the various forms of *alcohol* still continues to be along light routine lines. Consumers are still unsettled in their ideas as to future needs and are buying only from hand to mouth. *Ethyl alcohol* is readily available in most directions and prices range from \$4.65@\$4.90 per gal. Supplies of *denatured alcohol* are easy and moving very slowly, while prices range from 31@42c. per gal., depending on formula. Consumers of *methanol* are not showing any interest in future needs and confine themselves to picking up small odd lots at cheap prices.

COAL-TAR PRODUCTS

The market in the coal-tar products industry presented a steady tendency during the week, but trading was confined to the usual small-lot requirements for immediate use. The speculative boom in *beta naphthol* has been the feature of the intermediate market. Trading otherwise has been spotty along more or less routine lines. Stocks of *beta naphthol* have passed into firmer hands, but it is still questionable whether they will be able to hold out until the consuming demand returns. Manufacturers now quote 40c. per lb. for *beta*, while second hands in most quarters are not far below with 38c. as their asking price. Sellers are generally quoting 85c. per lb. on *para-nitraniline* for spot goods. The tone of the market is firmer and contract busi-

ness ranges around 90@95c. per lb. *Aniline oil* is being neglected, but prices are still unchanged and range from 20@25c. per lb.

Crude prices have shown no special changes during the week, although the tone is firmer on some items, while on others irregularities are noticeable. Spot and nearby stocks of *benzene* remain uncertain. Loose lots have been pretty well cleared away by consumers and the inquiry has subsided to a great extent. Occasional lots are offered by producers at 27@33c. per gal. for the pure in tank cars and drums. The *naphthalene* market is very dormant with all quoted prices subject to shading on firm business. The resale market is quoted around 7½@8c. per lb., but it is understood that bids as low as 7c. would receive consideration. Manufacturers are still holding to their former quotations. Prices on *dimethylaniline* are still more or less irregular in the absence of any noted demand. Odd lots are to be had at 40c. per lb., with stocks in resale hands quite plentiful at 42c. per lb. Makers are quoting up to 60c. per lb. for quantities. Speculative interests have taken over practically all the *beta-naphthol* in weak hands on the spot market and are holding for 38c. per lb. Occasional bona fide inquiries came in during the flurry, but these were very few and far between. Producers are holding their stocks, which are known to be quite heavy, at 40c. per lb. and up, according to quantity. Prices on *aniline oil* are unchanged from the former weak basis. Odd lots are to be had from resellers down to 18c. per lb. Others are asking 19@20c. per lb., drums extra. Manufacturers' figures ranged from 20@25c. per lb., according to brand and quantity, but actual business would bring about better prices. Few inquiries have been noted. Prices on *sulphanilic acid* are held around 30@32c. per lb. in spite of the weakness in aniline. No stocks of any magnitude could be located, so that producers are able to maintain the price level, even though the consuming demand is far below normal.

MISCELLANEOUS MATERIALS

The movement of miscellaneous materials into consuming channels was of fair proportions, some factors reporting that the demand was quite active for such items as litharge and blanc fixe. In fact the entire list of basic materials closed the week with no decline in prices. Traders reported a good outlet for *blanc fixe* and the market at the close was steady at 4½c. per lb. asked for carlots, immediate shipment. Production has been restricted in some directions. There was a moderate inquiry for litharge, and leading interests reported the market as steady on the basis of 8½c. per lb., in casks, for immediate and nearby delivery in carlots. Smaller quantities were quoted at 8½@8¾c. per lb. With no important change in zinc ores and the demand for *zinc oxide* improving, prices ruled steady. Tire manufacturers are taking on supplies in a freer manner. Leading producers quote the market for XX grade unchanged on the basis of 9c. per lb., nearby delivery.

WAXES

A moderate inquiry was noted for *beeswax* and prices in most instances ruled steady. African crude closed at 16@17c. per lb., according to quantity and seller, with Brazilian crude at 22@24c. per lb. Pure white wax was held at 42@45c. per lb. Further irregularity was noted in prices on *carnauba wax*, offerings being quite liberal, with the demand rather quiet. No. 2 North Country was offered at 26@28c. per lb., with quotations easy. No. 3 North Country was quoted at 16@17c. per lb., with the No. 3 chalky at 17@18c. Offerings of *Japan wax* were noted on the basis of 18@18½c. per lb. spot delivery. The market was reported rather dull. The market for *paraffine wax* was quiet and prices were subject to shading where round lots were involved. Prospective buyers restricted operations to a minimum on the assumption that the weakness in crude oil and the quiet export conditions could hardly bring about much of a change in the general situation. Scale wax, 122-124 deg. melting point, closed at 2½c. per lb. for carlots. Refined, 123-125 deg. melting point, was offered at 4c. per lb., with the 130-132 deg. melting point at 5@5½c. per lb.

The Chicago Market

CHICAGO, June 4, 1921.

There was a slow but steady improvement during the past two weeks in the tone of the industrial chemical market. Nearly all of the larger factors report a better inquiry and a larger volume of orders. It is also noticeable that the buyers are demanding immediate delivery, showing that present stocks in consumers' hands are either exhausted or very low. Prices as a rule are quite firm, with a few advances. There is but little distressed material left in the local market and the manufacturers or their agents are finding a steady inquiry for their products.

GENERAL CHEMICALS

Caustic soda is quoted at a slightly lower figure, although the inquiry is good for small lots. The solid 76 per cent is offered at 4c. and the ground at 4½@4¾c. per lb. There is a fair movement of *soda ash*, and supplies are available at \$2.60 per 100 lb. for barrels. The inquiry for *aluminum sulphate* is light and it is possible to get supplies of the ground technical at 2½c. per lb. *Ammonium carbonate* is quiet and the price is unchanged at 11c. per lb. for single casks. *Sal ammoniac* is firmer, although it is still possible to obtain small lots of the white granulated at 8½c. *Ammonium sulphate* is very quiet and the technical grade is offered at 3¾c. in bags. *Barium chloride* is dull and remains unchanged at \$75@\$85 per ton, according to the quantity. A fair demand for *epsom salts* was noted in some quarters, the prevailing price being 3½c. per lb. for the U.S.P. in barrels. *Formaldehyde* is lower, the new basis being 14½c. per lb. in barrels. The principal dealers report a fair volume of small orders and a few good inquiries.

Caustic potash remains in the same unsteady position, and ample supplies of the imported material are offered at 7½c. per lb., single casks. *Potassium permanganate* is unchanged and the inquiry is rather light. Material of foreign origin is offered at 33½@36c. per lb. *Bichromate of potash* is in a firmer position, and it is doubtful if supplies could be located at less than 15½c. per lb. *Sodium bichromate* has also shown a firmer tendency and material to arrive is offered at 9c. *Sodium bicarbonate* continues to move in a small way and dealers are maintaining prices at 2½@2¾c. per lb. *Nitrite of soda* is very firm and it is doubtful if supplies could be had at a figure lower than 8½c. There were several large inquiries for *zinc chloride* and the price was firm at 11½c. for spot material.

The general list of acids is quiet and unchanged as to price. *Glacial acetic* is very quiet, manufacturers quoting 11@11½c. per lb. The 28 per cent is moving in a fair way and is offered at 2¾@3c. per lb. for barrels. The warm weather affected the *citric acid* market and several good sales were noted. This material is offered by first hands at 47@48c. per lb., according to the size package. *Oxalic acid* is firm and quiet, foreign goods being held for 19c. in large casks and 20c. for the small barrels. *Sulphuric acid* is unchanged and makers continue to quote the 66 deg. at \$19@\$20 per ton in tank cars f.o.b. works.

VEGETABLE OILS, NAVAL STORES, COAL-TAR PRODUCTS

Quiet conditions still prevail in the vegetable oil trade and the only item worthy of attention is *linseed oil*. This material has fluctuated considerably during the past two weeks and the latest quotation noted was 85c. per gal. in barrels for the boiled and 83c. for the raw. Some factors report a fairly good volume of business.

The naval stores branch of the trade shows no signs of steadiness and prices are changing every day. *Turpentine* is now quoted at 71c. per gal. in drums and while the movement is not large, dealers are reporting an increase in orders. *Rosins* are steadier, although little or no business is reported. Prices as a rule are nominal and cover a wide range.

There was a slightly better inquiry noted for coal-tar products and dealers are hopeful of better times in the near future. Prices on *benzene* are unchanged and 31c. per gal. for the 100 per cent in drums was the best offer noted. *Toluene* is available at the same price, but the movement is slight.

The Iron and Steel Market

PITTSBURGH, June 3, 1921.

The case of the steel market seems to be that the particularly dull season usually beginning about July 1 has come a month ahead of time. In all quarters the volume of buying has decreased and in the past week the turnover has been unprecedentedly light. If the present volume of steel buying is the natural volume for an industrial depression, for a period of hard times, then the amount of business last winter was phenomenally large, although at the time it was considered very small.

The natural appraisal is that the present is a temporary condition, not characteristic of an industrial depression in general. Most business historians regard the period 1893 to 1898 inclusive as a period of industrial depression, yet three of those six years witnessed new records in pig-iron production.

Instead of being disappointed by the fresh degree of stagnation the iron and steel market now exhibits, producers are encouraged in their hope that August would witness a revival, and in most quarters the hope has turned into a definite prediction. Full activity is not expected for any time this year.

The rate of steel production has dropped to about 25 per cent of capacity, against rates of 30 or 31 per cent in April and about 80 per cent during the first nine months of last year.

One influence that has often helped in a revival in steel buying cannot be counted upon this time, and that is replenishment of buyers' stocks due to buyers acquiring the fear that prompt deliveries cannot be secured. Very prompt mill shipment is possible now, many carload orders being shipped within a day or two of their receipt, the chief cause of delay being that a mill is temporarily idle. With an increase in buying, therefore, shipments would not become less prompt.

STEEL PRICES

The ordinary transactions of the day in steel products are in carload lots, any order of larger size being more or less exceptional. On carload orders, as a rule, the steel prices developed about the middle of April are being maintained, 2.10c. for bars, 2.20c. for shapes and plates, and so on. In some commodities concessions are possible on larger orders, but in a strong and active market occasional concessions are not unknown.

Evidently all or nearly all buyers are convinced that steel prices will be lower within a short time, probably within two months. Steel producers naturally do not make definite predictions, but they show no disposition to take issue with this view. What the mills would prefer would be a reduction, perhaps a fairly heavy reduction, so timed as to stimulate a buying movement. Such a reduction could not be timed this month or in July, as buyers would take no interest. August would be different. The principle involved is that costs are particularly high now, both on account of poor distribution of overhead and on account of labor employment per ton of output being particularly heavy with so light an operation, and that an increase in buying, leading to a heavier operation, would reduce costs and thus pay for the price reduction involved.

PIG IRON AND COKE

Buying of pig iron remains of very small proportions, and with the present rate the stocks at merchant furnaces will last for several months. Carload lot sales of bessemer iron show a price of \$23 valley, against the nominal market of \$24 hitherto quoted. Basic, formerly quotable at \$22 valley, has sold at \$21.75 if not at \$21.50. Foundry is quotable at \$23 against \$23.50.

Connellsville coke for spot shipment remains at \$3.25@ \$3.50 for furnace, while foundry is down 25c., at \$4.75@ \$5.25. The Robeson Iron Co., which makes low-phosphorus pig iron, is understood to have bought a four months' supply of the low-phosphorus coke requisite, available from only about three works in the Connellsville region, at a shade under \$3.75.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

	Carlots	Less Carlots
Acetic anhydride.....lb.	—	\$0.40 - \$0.45
Acetone.....lb.	\$0.12 - \$0.12	.13 - .13
Acetic, 28 per cent.....100 lbs.	2.50 - 2.75	3.00 - 3.25
Acetic, 56 per cent.....100 lbs.	4.00 - 4.25	4.50 - 5.50
Acetic, glacial, 99 1/2 per cent, carboys, 100 lbs.	9.75 - 10.00	10.25 - 10.50
Boric, crystals.....lb.	.13 - .14	.14 - .15
Boric, powder.....lb.	.15 - .15	.16 - .16
Citric.....lb.	—	.44 - .45
Hydrochloric, 52 per cent.....100 lb.	1.50 - 1.65	1.75 - 2.00
Hydrofluoric, 52 per cent.....lb.	.12 - .12	.12 - .13
Lactic, 44 per cent tech.....lb.	.10 - .11	.11 - .12
Lactic, 22 per cent tech.....lb.	.04 - .05	.06 - .07
Molybdic, C. P.....lb.	4.00 - 4.50	4.50 - 5.00
Muriatic, 20 deg. (see hydrochloric).....lb.	—	.07 - .07
Nitric, 40 deg.....lb.	.06 - .06	.07 - .07
Nitric, 42 deg.....lb.	.07 - .07	.07 - .08
Oxalic, crystals.....lb.	.16 - .17	.17 - .17
Phosphoric, Ortho, 50 per cent solution.....lb.	.17 - .17	.18 - .19
Picric.....lb.	.20 - .25	.27 - .35
Pyrogallol, resublimed.....lb.	—	1.90 - 2.15
Sulphuric, 60 deg., tank cars.....ton	—	11.00 - 12.00
Sulphuric, 60 deg., drums.....ton	—	13.00 - 15.00
Sulphuric, 66 deg., tank cars.....ton	18.00 - 20.00	—
Sulphuric, 66 deg., drums.....ton	22.00 - 22.50	23.00 - 23.50
Sulphuric, 66 deg., carboys.....ton	—	—
Sulphuric, fuming, 20 per cent (oleum) tank cars.....ton	23.00 - 24.00	—
Sulphuric, fuming, 20 per cent (oleum) drums.....ton	25.00 - 26.00	26.50 - 27.00
Sulphuric, fuming, 20 per cent (oleum) carboys.....ton	31.00 - 32.00	33.00 - 34.00
Tannic, U. S. P.....lb.	—	.90 - 1.00
Tannic (tech.).....lb.	.50 - .52	.54 - .57
Tartaric, crystals.....lb.	—	.30 - .32
Tungstic, per lb. of WO.....lb.	—	1.30 - 1.40
Alcohol, Ethyl.....gal.	—	4.65 - 4.90
Alcohol, Methyl (see methanol).....gal.	—	—
Alcohol, denatured, 188 proof.....gal.	—	.31 - .36
Alcohol, denatured, 190 proof.....gal.	—	.38 - .42
Alum, ammonia lump.....lb.	.03 - .04	.04 - .04
Alum, potash lump.....lb.	.04 - .04	.04 - .05
Alum, chrome lump.....lb.	.13 - .13	.14 - .14
Aluminium sulphate, commercial.....lb.	.01 - .02	.02 - .02
Aluminium sulphate, iron free.....lb.	.03 - .03	.03 - .04
Aqua ammonia, 26 deg., drums (750 lb.).....lb.	.07 - .07	.08 - .08
Ammonia, anhydrous, cyl. (100-150 lb.).....lb.	.30 - .32	.33 - .35
Ammonium carbonate, powder.....lb.	.08 - .08	.09 - .10
Ammonium chloride, granular (white ammoniac).....lb.	.06 - .06	.07 - .07
Ammonium chloride, granular (gray ammoniac).....lb.	.07 - .08	.08 - .08
Ammonium nitrate.....lb.	.08 - .08	.09 - .10
Ammonium sulphate.....100 lb.	2.50 - 2.75	2.80 - 2.90
Amlyacetate.....gal.	—	4.00 - 4.25
Amlyacetate tech.....gal.	—	2.50 - 3.00
Arsenic oxide, (white arsenic) powdered.....lb.	.07 - .08	.08 - .08
Arsenic sulphide, powdered (red arsenic).....lb.	.12 - .12	.13 - .14
Barium chloride.....ton	60.00 - 62.00	63.00 - 65.00
Barium dioxide (peroxide).....lb.	.19 - .20	.21 - .22
Barium nitrate.....lb.	.08 - .09	.09 - .10
Barium sulphate (precip.) (blanc fixe).....lb.	.04 - .05	.05 - .06
Bleaching powder (see calc. hypochlorite).....lb.	—	—
Blue vitriol (see copper sulphate).....lb.	—	—
Borax (see sodium borate).....lb.	—	—
Brimstone (see sulphur, roll).....lb.	—	—
Bromine.....lb.	.41 - .42	.43 - .45
Calcium acetate.....100 lbs.	2.00 - 2.05	—
Calcium carbide.....lb.	.05 - .05	.06 - .06
Calcium chloride, fused, lump.....ton	24.00 - 25.00	26.00 - 27.00
Calcium chloride, granulated.....lb.	.01 - .02	.02 - .02
Calcium hypochlorite (bleach powder) 100 lb.	2.25 - 2.40	2.50 - 2.75
Calcium peroxide.....lb.	—	1.40 - 1.50
Calcium phosphate, tribasic.....lb.	—	.15 - .16
Camphor.....lb.	—	.68 - .70
Carbon bisulphide.....lb.	.06 - .07	.07 - .08
Carbon tetrachloride, drums.....lb.	.10 - .10	.11 - .12
Carbonyl chloride (phosgene).....lb.	—	.75 - 1.00
Caustic potash (see potassium hydroxide).....lb.	—	—
Caustic soda (see sodium hydroxide).....lb.	—	—
Chlorine, gas, liquid-cylinders (100 lb.).....lb.	.08 - .09	.09 - .10
Chloroform.....lb.	—	.42 - .44
Cobalt oxide.....lb.	—	3.00 - 3.10
Copperas (see iron sulphate).....lb.	—	—
Copper carbonate, green precipitate.....lb.	.20 - .21	.22 - .23
Copper cyanide.....lb.	—	.50 - .62
Copper sulphate, crystals.....lb.	.05 - .05	.06 - .06
Cream of tartar (see potassium bitartrate).....lb.	—	—
Epsom salt (see magnesium sulphate).....lb.	—	—
Ethyl Acetate Com. 85%.....gal.	—	1.00 - 1.05
Ethyl Acetate pure (acetic ether 98% to 100%).....lb.	—	.50 - .52
Formaldehyde, 40 per cent.....lb.	.14 - .14	.15 - .15
Fusel oil, ref.....gal.	—	3.00 - 3.25
Fusel oil, crude.....gal.	—	1.75 - 2.00
Glauber's salt (see sodium sulphate).....lb.	—	—
Glycerine, C. P. drums extra.....lb.	—	.16 - .17
Iodine, resublimed.....lb.	—	3.65 - 3.75
Iron oxide, red.....lb.	—	.10 - .20
Iron sulphate (copperas).....100 lb.	1.00 - 1.25	1.50 - 1.75
Lead acetate.....lb.	—	.11 - .13
Lead arsenate, basic.....lb.	.09 - .09	.10 - .11
Lead nitrate.....lb.	—	.15 - .20
Litharge.....lb.	.08 - .08	.08 - .09
Lithium carbonate.....lb.	—	1.30 - 1.40
Magnesium carbonate, technical.....lb.	.09 - .09	.10 - .11
Magnesium sulphate, U. S. P.....100 lb.	2.75 - 3.00	—
Magnesium sulphate, technical.....100 lb.	—	1.10 - 2.25
Methanol, 95%.....gal.	—	.75 - .77
Methanol, 97%.....gal.	—	.78 - .82
Nickel salt, double.....lb.	—	.14 - .14
Nickel salt, single.....lb.	—	.15 - .15
Phosgene (see carbonyl chloride).....lb.	—	—
Phosphorus, red.....lb.	.45 - .46	.47 - .50
Phosphorus, yellow.....lb.	—	.35 - .37
Potassium bichromate.....lb.	.12 - .12	.12 - .13

	Carlots	Less Carlots
	lb. \$ - \$	\$0.31 - \$0.32
Potassium bitartrate (cream of tartar)	lb. 35 - 40	16 - 25
Potassium bromide, granular	lb. 06 - 06	45 - 50
Potassium carbonate, U. S. P.	lb. 06 - 06	06 - 07
Potassium carbonate, 80-85%	lb. 08 - 10	10 - 14
Potassium chlorate, crystals	lb. 05 - 05	26 - 28
Potassium cyanide	lb. 05 - 05	06 - 08
Potassium hydroxide (caustic potash)	ton 50.00 - 53.00	2.75 - 3.00
Potassium iodide	lb. 09 - 09	10 - 12
Potassium nitrate	lb. 35 - 36	37 - 38
Potassium permanganate	lb. 35 - 37	38 - 40
Potassium prussiate, red	lb. 26 - 26	27 - 28
Potassium prussiate, yellow	per unit	1.50 - 1.75
Potassium sulphate (powdered)	ton	32.00 - 33.00
Rochelle salts (see sodium potas. tartrate)		
Sal ammoniac (see ammonium chloride)		
Sal soda (see sodium carbonate)		
Salt cake	ton	1.35 - 1.38
Silver cyanide	oz.	40 - 41
Silver nitrate	100 lb. 2.20 - 2.25	2.30 - 2.70
Soda ash, light	100 lb. 2.45 - 2.50	2.60 - 2.75
Soda ash, dense	100 lb. 04 - 04	05 - 05
Sodium acetate	100 lb. 2.25 - 2.40	2.50 - 2.75
Sodium bicarbonate	100 lb. 08 - 08	08 - 09
Sodium bichromate	ton 5.00 - 5.25	5.50 - 6.50
Sodium bisulphate (nitre cake)	lb. 05 - 05	05 - 06
Sodium bisulphate powdered, U. S. P.	lb. 06 - 06	07 - 07
Sodium borate (borax)	100 lb. 1.90 - 2.00	2.10 - 2.40
Sodium carbonate (sal soda)	lb. 07 - 07	08 - 08
Sodium chloride	lb. 22 - 24	25 - 30
Sodium cyanide	lb. 12 - 12	13 - 14
Sodium fluoride	100 lb. 4.00 - 4.05	4.10 - 4.50
Sodium hydroxide (caustic soda)	100 lb. 2.90 - 3.00	3.00 - 3.03
Sodium hyposulphite	100 lb. 07 - 08	08 - 10
Sodium nitrate	100 lb. 25 - 26	27 - 30
Sodium peroxide, powdered	lb. 04 - 04	05 - 05
Sodium phosphate, dibasic	121 - 13	13 - 14
Sodium potassium tartrate (Rochelle salts)	1.25 - 1.35	1.40 - 1.50
Sodium prussiate, yellow	02 - 03	03 - 03
Sodium silicate, solution (40 deg.)	1.50 - 1.75	2.00 - 2.25
Sodium silicate, solution (60 deg.)	05 - 05	06 - 06
Sodium sulphate, crystals (Glauber's salt)	100 lbs. 03 - 04	04 - 04
Sodium sulphide, fused, 60-62 per cent (cone.)	lb. 15 - 15	16 - 17
Sodium sulphite, crystals	lb. 07 - 07	07 - 08
Strontium nitrate, powdered	ton 20.00 - 22.00	29 - 30
Sulphur, crude	100 lb. 08 - 08	09 - 10
Sulphur dioxide, liquid, cylinders extra	100 lb. 2.50 - 2.50	2.50 - 2.75
Sulphur (sublimed), flour	100 lb. 18 - 19	40 - 42
Sulphur, roll (brimstone)	100 lb. 16 - 18	19 - 20
Tin bichloride, 50 per cent	lb. 11 - 11	11 - 12
Tin oxide	lb. 45 - 49	50 - 60
Zinc carbonate, precipitate	lb. 12 - 13	13 - 14
Zinc chloride, gran.	lb. 09 - 09	09 - 10
Zinc cyanide	lb. 03 - 03	04 - 05
Zinc dust		
Zinc oxide, XX		
Zinc sulphate		

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha-naphthol, crude	lb. \$1.10 - \$1.15
Alpha-naphthol, refined	lb. 1.25 - 1.30
Alpha-naphthylamine	lb. 35 - 40
Aniline oil, drums extra	lb. 19 - 25
Aniline salts	lb. 26 - 29
Anthracene, 80% in drums (100 lb.)	lb. 75 - 1.00
Benzaldehyde U.S.P.	lb. 1.50 - 1.75
Benzidine, base	lb. 85 - 1.00
Benzidine sulphate	lb. 75 - 85
Benzoic acid, U.S.P.	lb. 60 - 65
Benzoate of soda, U.S.P.	lb. 65 - 70
Benzene, pure, water-white, in drums (100 gal.)	gal. 27 - 32
Benzene, 90% in drums (100 gal.)	gal. 25 - 28
Benzyl chloride, 95-97% refined	lb. 28 - 30
Benzyl chloride, tech.	lb. 20 - 25
Beta-naphthol benzoate	lb. 3.50 - 4.00
Beta-naphthol, sublimed	lb. 70 - 75
Beta-naphthol, tech.	lb. 38 - 40
Beta-naphthylamine, sublimed	lb. 2.00 - 2.25
Cresol, U. S. P., in drums (100 lb.)	lb. 16 - 18
Ortho-cresol, in drums (100 lb.)	lb. 25 - 27
Cresylic acid, 97-99%, straw color, in drums	gal. 70 - 80
Cresylic acid, 75-97%, dark, in drums	gal. 65 - 70
Cresylic acid, 50%, first quality, drums	gal. 45 - 50
Dichlorobenzene	lb. 06 - 09
Diethylaniline	lb. 1.20 - 1.25
Dimethylaniline	lb. 41 - 50
Dinitrobenzene	lb. 32 - 35
Dinitrochlorobenzene	lb. 20 - 30
Dinitronaphthalene	lb. 30 - 40
Dinitrophenol	lb. 35 - 40
Dinitrotoluene	lb. 27 - 30
Dip oil, 25%, ear lots, in drums	gal. 40 - 45
Diphenylamine	lb. 60 - 65
H-acid	lb. 1.25 - 1.35
Meta-phenylenediamine	lb. 1.15 - 1.20
Monochlorobenzene	lb. 12 - 14
Monoethylaniline	lb. 1.75 - 1.85
Naphthalene crushed, in bbls.	lb. 07 - 08
Naphthalene, flake	lb. 07 - 08
Naphthalene, balls	lb. 08 - 09
Naphthionic acid, crude	lb. 70 - 75
Nitrobenzene	lb. 12 - 15
Nitro-naphthalene	lb. 30 - 35
Nitro-toluene	lb. 16 - 18
Ortho-amidophenol	lb. 3.10 - 3.20
Ortho-dichlorobenzene	lb. 15 - 20
Ortho-nitro-phenol	lb. 80 - 85
Ortho-nitro-toluene	lb. 15 - 20
Ortho-toluidine	lb. 20 - 25
Para-amidophenol, base	lb. 1.50 - 1.60
Para-amidophenol, HCl	lb. 1.75 - 1.80

Para-dichlorobenzene	lb. 15 - 20
Paranitroaniline	lb. 85 - 1.00
Para-nitrotoluene	lb. 90 - 1.00
Para-phenylenediamine	lb. 1.95 - 2.00
Para-toluidine	lb. 1.25 - 1.40
Phthalic anhydride	lb. 50 - 60
Phenol, U. S. P., drums	lb. 09 - 12
Pyridine	gal. 2.00 - 3.50
Resorcinol, technical	lb. 1.75 - 1.85
Resorcinol, pure	lb. 2.25 - 2.30
Salicylic acid, tech., in bbls.	lb. 22 - 24
Salicylic acid, U. S. P.	lb. 26 - 28
Salol	lb. 80 - 85
Solvent naphtha, water-white, in drums, 100 gal.	gal. 25 - 28
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal. 14 - 16
Sulphanilic acid, crude	lb. 30 - 35
Tolidine	lb. 1.25 - 1.35
Toluidine, mixed	lb. 40 - 45
Toluene, in tank cars	gal. 25 - 28
Toluene, in drums	gal. 28 - 31
Xylidines, drums, 100 gal.	lb. 40 - 45
Xylene, pure, in drums	gal. 40 - 45
Xylene, pure, in tank cars	gal. 45 - 45
Xylene, commercial, in drums, 100 gal.	gal. 33 - 35
Xylene, commercial, in tank cars	gal. 30 - 35

Waxes

Prices based on original packages in large quantities.

Beeswax, refined, dark	lb. \$0.23 - \$0.25
Beeswax, refined, light	lb. 25 - 27
Beeswax, white pure	lb. 42 - 45
Carnauba, Florida	lb. 61 - 62
Carnauba, No. 2, North Country	lb. 27 - 28
Carnauba, No. 3, North Country	lb. 16 - 17
Japan	lb. 18 - 18
Montan, crude	lb. 07 - 07
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb. 03 - 03
Paraffine waxes, crude, scale 124-126 m.p.	lb. 02 - 02
Paraffine waxes, refined, 118-120 m.p.	lb. 03 - 03
Paraffine waxes, refined, 125 m.p.	lb. 04 - 04
Paraffine waxes, refined, 128-130 m.p.	lb. 04 - 05
Paraffine waxes, refined, 133-135 m.p.	lb. 05 - 05
Paraffine waxes, refined, 135-137 m.p.	lb. 05 - 06
Stearic acid, single pressed	lb. 09 - 10
Stearic acid, double pressed	lb. 10 - 11
Stearic acid, triple pressed	lb. 11 - 11

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on earload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.	280 lb. \$5.00 - 6.00
Rosin E-L	280 lb. 5.80 - 6.00
Rosin K-N	280 lb. 6.50 - 6.70
Rosin W. G.-W. W.	280 lb. 6.80 - 7.00
Wood rosin, bbl.	280 lb. 6.25 - 6.50
Spirits of turpentine	gal. 61 - 61
Wood turpentine steam dist.	gal. 59 - 59
Wood turpentine, dest. dist.	gal. 57 - 57
Pine tar pitch, bbl.	200 lb. 6.75 - 6.75
Tar, kiln burned, bbl. (500 lb.)	bbl. 12.00 - 12.00
Retort tar, bbl.	500 lb. 12.00 - 12.00
Rosin oil, first run	gal. 36 - 36
Rosin oil, second run	gal. 38 - 38
Rosin oil, third run	gal. 43 - 43
Pine oil, steam dist., sp.gr. 0.930-0.940	gal. \$1.80 - 1.80
Pine oil, pure, dest. dist.	gal. 1.50 - 1.50
Pine tar oil, ref., sp.gr. 1.025-1.035	gal. 46 - 46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal. 35 - 35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal. 75 - 75
Pine tar, ref., thin, sp.gr. 1.080-1.060	gal. 35 - 35
Turpentine, crude, sp. gr. 0.900-0.970	gal. 1.20 - 1.20
Hardwood oil, f.o.b. Mich., sp. gr. 0.960-0.990	gal. 35 - 35
Pinewood creosote, ref.	gal. 52 - 52

Solvents

73-76 deg., steel bbls. (85 lb.)	gal. \$0.41 - 0.41
70-72 deg., steel bbls. (85 lb.)	gal. 39 - 39
68-70 deg., steel bbls. (85 lb.)	gal. 38 - 38
V. M. and P. naphtha, steel bbls. (85 lb.)	gal. 30 - 30

Crude Rubber

Para-Upriver fine	lb. \$0.16 - 0.17
Upriver coarse	lb. 09 - 09
Upriver caucho ball	lb. 11 - 12
Plantation—First latex crepe	lb. 17 - 17
Ribbed smoked sheets	lb. 15 - 15
Brown crepe, thin, clean	lb. 15 - 15
Amber crepe No. 1	lb. 17 - 17

Oils

VEGETABLE

The following prices are f.o.b. New York for earload lots.

Castor oil, No. 3, in bbls.	lb. \$0.08 - \$0.09
Castor oil, AA, in bbls.	lb. 10 - 10
China wood oil, in bbls. (f.o.b. Pac. coast)	lb. 12 - 12
Cocunut oil, Ceylon grade, in bbls.	lb. 10 - 10
Cocunut oil, Cochon grade, in bbls.	lb. 11 - 11
Corn oil, crude, in bbls.	lb. 07 - 08
Cottonseed oil, crude (f. o. b. mill)	lb. 05 - 05
Cottonseed oil, summer yellow	lb. 07 - 07
Cottonseed oil, winter yellow	lb. 08 - 08
Linseed oil, raw, ear lots (domestic)	gal. 73 - 73
Linseed oil, raw, tank cars (domestic)	gal. 67 - 67
Linseed oil, in 5-bbl lots (domestic)	gal. 76 - 76

Olive oil, Denatured.....	gal.	\$1.35	—	\$1.50
Palm, Lagos.....	lb.	.07	—	.07
Palm, Niger.....	lb.	.05	—	.06
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	.06	—	.06
Peanut oil, refined, in bbls.....	lb.	.10	—	.10
Rapeseed oil, refined in bbls.....	gal.	.86	—	.88
Rapeseed oil, blown, in bbls.....	gal.	.92	—	.94
Soya bean oil (Manchurian), in bbls, N. Y.....	lb.	.07	—	.07
Soya bean oil, tank cars, f.o.b., Pacific coast.....	lb.	.05	—	.05

FISH

Light pressed menhaden.....	gal.	\$0.40	—	\$0.41
Yellow bleached menhaden.....	gal.	.42	—	.42
White bleached menhaden.....	gal.	.44	—	.44
Blown menhaden.....	gal.	.80	—	.80

Miscellaneous Materials

All f.o.b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.....	net ton	\$24.00	—	30.00
Barytes, ground, off color, f.o.b. Kings Creek.....	net ton	22.00	—	26.00
Barytes, crude, 88% to 94% ba., Kings Creek.....	net ton	10.00	—	1.00
Barytes, floated, f.o.b. St. Louis.....	net ton	26.50	—	28.00
Barytes, crude, first grade, Missouri.....	net ton	7.00	—	.00
Blanc fixe, dry.....	lb.	.05	—	.05
Blanc fixe, pulp.....	net ton	50.00	—	60.00
Casein.....	lb.	.14	—	.16
Chalk, domestic, extra light.....	lb.	.05	—	.05
Chalk, domestic, light.....	lb.	.04	—	.05
Chalk, domestic, heavy.....	lb.	.04	—	.05
Chalk, English, extra light.....	lb.	.05	—	.07
Chalk, English, light.....	lb.	.05	—	.06
Chalk, English, dense.....	lb.	.04	—	.05
China clay (kaolin) crude, f.o.b. mines, Georgia.....	net ton	8.00	—	10.00
China clay (kaolin) washed, f.o.b. Georgia.....	net ton	12.00	—	15.00
China clay (kaolin) powdered, f.o.b. Georgia.....	net ton	18.00	—	22.00
China clay (kaolin) crude f.o.b. Virginia points.....	net ton	8.00	—	12.00
China clay (kaolin) ground, f.o.b. Virginia points.....	net ton	15.00	—	40.00
China clay (kaolin), imported, lump.....	net ton	23.00	—	25.00
China clay (kaolin), imported, powdered.....	net ton	30.00	—	35.00
Feldspar, crude, f.o.b. Maryland and North Carolina points.....	gross ton	8.00	—	14.00
Feldspar, crude, f.o.b. Maine.....	net ton	7.50	—	10.00
Feldspar, ground, f.o.b. Maine.....	net ton	21.00	—	23.00
Feldspar, ground, f.o.b. North Carolina.....	net ton	17.00	—	21.00
Feldspar, ground, f.o.b. N. Y. State.....	net ton	17.00	—	21.00
Feldspar, ground, f.o.b. Baltimore.....	net ton	27.00	—	30.00
Fullers earth, f.o.b. Mines.....	net ton	16.00	—	17.00
Fullers earth, granular, f.o.b. Pa.....	net ton	15.00	—	18.00
Fullers earth, powdered, f.o.b. Fla.....	net ton	18.00	—	.00
Fullers earth, imported, powdered.....	net ton	24.00	—	27.00
Graphite, Ceylon lump, first quality.....	lb.	.07	—	.08
Graphite, Ceylon chip.....	lb.	.06	—	.06
Graphite, high grade amorphous crude.....	lb.	.02	—	.03
Pumice stone, imported, lump.....	lb.	.04	—	.50
Pumice stone, domestic lump.....	lb.	.05	—	.05
Pumice stone, ground.....	lb.	.06	—	.07
Quartz (acid tower) first to head, f.o.b. Baltimore.....	net ton	.00	—	10.00
Quartz (acid tower) 1 1/2 in., f.o.b. Baltimore.....	net ton	.00	—	14.00
Quartz (acid tower) rice, f.o.b. Baltimore.....	net ton	.00	—	17.00
Quartz, lump, f.o.b. North Carolina.....	net ton	5.00	—	7.50
Shellac, orange fine.....	lb.	.75	—	.00
Shellac, orange superfine.....	lb.	.79	—	.82
Shellac, A. C. garnet.....	lb.	.55	—	.58
Shellac, T. N.....	lb.	.70	—	.72
Soapstone.....	ton	12.00	—	15.00
Sodium chloride.....	long ton	12.50	—	13.00
Talc, paper-making grades, f.o.b. Vermont.....	ton	11.00	—	20.00
Talc, roofing grades, f.o.b. Vermont.....	ton	8.50	—	13.00
Talc, rubber grades, f.o.b. Vermont.....	ton	11.00	—	18.00
Talc, powdered, Southern, f.o.b. cars.....	ton	10.00	—	14.00
Talc, imported.....	ton	35.00	—	40.00
Talc, California talcum powder grade.....	ton	18.00	—	40.00

Refractories

Bauxite brick, 56% Al, f.o.b. Pittsburgh.....	per ton	\$35.00	—	50.00
Carborundum refractory brick, 9-in.	1,000	1,250.00	—	
Chrome brick, f.o.b. Eastern shipping points.....	net ton	75.00	—	90.00
Chrome cement, 40-45% Cr ₂ O ₃	net ton	45.00	—	50.00
Chrome cement, 40-45% Cr ₂ O ₃ , sacks, in car lots, f.o.b. Eastern shipping points.....	net ton	.00	—	55.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works.....	1,000	40.00	—	50.00
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works.....	1,000	40.00	—	50.00
Magnesite brick, 9-in. straight.....	net ton	.00	—	90.00
Magnesite brick, 9-in. arches, wedges and keys.....	net ton	.00	—	100.00
Magnesite brick, soaps and splits.....	net ton	.00	—	110.00
Silica brick, 9-in. sizes, f.o.b. Chicago district.....	1,000	45.00	—	55.00
Silica brick, 9-in. sizes, f.o.b. Birmingham district.....	1,000	45.00	—	55.00
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa.....	1,000	45.00	—	55.00

Ferro-Alloys

All f.o.b. Works

Ferro-titanium, 15-18% Ti, f.o.b. Niagara Falls, N. Y.....	net ton	\$200.00	—	\$225.00
Ferromanganese, per lb. of Cr. contained, 6-8% carbon, carlots.....	lb.	.15	—	.16
Ferromanganese, per lb. of Cr. contained, 4-6% carbon, carlots.....	lb.	.16	—	.17
Ferromanganese, 76-80% Mn, domestic.....	gross ton	80.00	—	82.00
Ferromanganese, 76-80% Mn, English.....	gross ton	80.00	—	82.00
Spiegelisen, 18-22% Mn.....	gross ton	30.00	—	32.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo.....	lb.	2.50	—	.00
Ferrosilicon, 10-15%.....	gross ton	50.00	—	55.00
Ferrosilicon, 50%.....	gross ton	80.00	—	85.00
Ferrosilicon, 75%.....	gross ton	145.00	—	150.00
Ferrotungsten, 70-80%, per lb. of contained W.....	lb.	.45	—	.50
Ferroumium, 35-50% of U, per lb. of U content.....	lb.	6.00	—	.00
Ferrovandium, 30-40% of contained V.....	lb.	5.00	—	6.50

Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al content.....	gross ton	\$8.00	—	\$10.00
Chrome ore, Calif. concentrates, 50% min. Cr ₂ O ₃	unit	.45	—	.50
Chrome ore, 50% Cr ₂ O ₃ , f.o.b. Atlantic seaboard.....	unit	.45	—	.50
Coke, foundry, f.o.b. ovens.....	net ton	4.50	—	5.00
Coke, furnace, f.o.b. ovens.....	net ton	3.25	—	3.75
Coke, petroleum, refinery, Atlantic seaboard.....	net ton	15.00	—	16.00
Fluorspar, lump, f.o.b. mines, New Mexico.....	net ton	15.00	—	.00
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines.....	net ton	20.00	—	22.50
Ilmenite, 52% TiO ₂ , per lb. ore.....	lb.	.01	—	.01
Manganese ore, 50% Mn, c.i.f. Atlantic seaport.....	unit	.25	—	.00
Manganese ore, chemical (MnO ₂).....	gross ton	60.00	—	65.00
Molybdenite, 85% MoS ₂ , per lb. of MoS ₂ , N. Y.....	lb.	.55	—	.60
Monazite, per unit of ThO ₂ , c.i.f. Atlantic seaport.....	unit	30.00	—	.00
Pyrites, Spanish, fines, c.i.f. Atlantic seaport.....	unit	.14	—	.14
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport.....	unit	.14	—	.14
Pyrites, domestic, fines, f.o.b. mines, Ga.....	unit	.12	—	.13
Rutile, 95% TiO ₂ per lb. ore.....	lb.	.15	—	.00
Tungsten, scheelite, 60% WO ₃ and over, per unit of WO ₃ (nominal).....	unit	2.75	—	3.00
Tungsten, Wolframite, 60% WO ₃ and over, per unit of WO ₃ , N. Y. C.....	unit	3.00	—	3.25
Uranium ore (carnotite) per lb. of U ₃ O ₈	lb.	1.50	—	2.50
Uranium oxide, 96% per lb. contained U ₃ O ₈	lb.	2.25	—	2.50
Vanadium pentoxide, 99%.....	lb.	12.00	—	14.00
Vanadium ore, per lb. of V ₂ O ₅ contained.....	lb.	1.50	—	.00
Zircon, washed, iron free.....	lb.	.03	—	.00

Non-Ferrous Metals

New York Markets

	Cents per Lb.
Copper, electrolytic.....	13.25-13.50
Aluminum, 98 to 99 per cent.....	28.00-28.50
Antimony, wholesale lots, Chinese and Japanese.....	5.00
Nickel, ordinary (ingot).....	41.00
Nickel, electrolytic.....	44.00
Monel metal, spot and blocks.....	35.00
Monel metal ingots.....	38.00
Monel metal, sheet bars.....	40.00
Tin, 5-ton lots, Straits.....	31.25
Lead, New York, spot.....	4.75-4.85
Lead, E. St. Louis, spot.....	4.60-4.75
Zinc, spot, New York.....	5.20
Zinc, spot, E. St. Louis.....	4.70

OTHER METALS

Silver (commercial).....	oz.	\$0.58
Cadmium.....	lb.	1.00-1.25
Bismuth (500 lb. lots).....	lb.	1.50-1.55
Cobalt.....	lb.	4.00
Magnesium (f.o.b. Philadelphia).....	lb.	1.25
Platinum.....	oz.	75.00
Iridium.....	oz.	250.00-300.00
Palladium.....	oz.	70.00
Mercury.....	75 lb.	46.00-47.00

FINISHED METAL PRODUCTS

Warehouse Price
Cents per Lb.

Copper sheets, hot rolled.....	20.50-20.75
Copper bottoms.....	28.00-28.25
Copper rods.....	19.25-20.00
High brass wire.....	18.25
High brass rods.....	15.25
Low brass wire.....	20.25
Low brass rods.....	20.25
Braced brass tubing.....	29.00
Braced bronze tubing.....	34.25
Seamless copper tubing.....	22.00
Seamless high brass tubing.....	21.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York Current	Cleveland	Chicago
Copper, heavy and crucible.....	8.50-9.00	9.00	9.50
Copper, heavy and wire.....	8.00-8.25	8.50	8.50
Copper, light and bottoms.....	7.00-7.50	7.50	7.00
Lead, heavy.....	3.25-3.50	3.25	3.25
Lead, tea.....	2.15-2.30	2.00	2.00
Brass, heavy.....	4.25-4.50	4.50	5.00
Brass, light.....	3.00-3.25	3.00	3.50
No. 1 yellow brass turnings.....	4.00-4.25	4.00	4.50
Zinc.....	2.00-2.50	2.00	2.50

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by 1 in. and larger, and plates 1 in. and heavier, from jobbers' warehouses in the cities named:

	New York	Cleveland	Chicago
Structural shapes.....	\$2.50	\$3.23	\$3.23
8-ft steel bars.....	2.50	3.00	3.13
Soft steel bar shapes.....	2.50	3.13	3.13
Soft steel bands.....	2.85	3.83	3.78
Plates, 1 to 1 in. thick.....	2.50	3.30	3.23

*Add 15¢ per 100 lb. for trucking to Jersey City and 10¢ for delivery in New York and Brooklyn

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

DOTHAN—The Home Guano Co. is planning for the rebuilding of its fertilizer manufacturing plant, recently destroyed by fire. A complete new machinery installation will be made, including considerable transmission equipment as pulleys, hangers, gearing, etc. M. L. Hanahan is treasurer and general manager.

Alberta

EDMONTON—The Imperial Oil Co. is planning for the construction of a new oil refinery near Fort Norman, Alta.; operations will be concentrated in a large measure to gasoline production at the new works.

Arkansas

MENA—The Cora C. Mining Co., is planning for the installation of considerable new machinery at its manganese properties in the vicinity of Hatten, Ark. The company has a tract of about 600 acres of land in this section. J. D. Budd is president and general manager.

LITTLE ROCK—The Rose City Petroleum Co., 407 Donaghey Bldg., has awarded a contract to Edwards & Dore, Little Rock, for the erection of its proposed new oil refinery, estimated to cost about \$55,000, and of which amount approximately \$25,000 will be expended for machinery. The plant will have an initial output of about 1,000 bbl. of oil per day. The company was recently incorporated with a capital of \$500,000. E. B. Fowler is secretary and treasurer.

EL DORADO—The Transcontinental Oil Co., Tulsa, Okla., is considering the construction of a new oil refinery in the vicinity of El Dorado.

California

VISALIA—The Central Counties Gas Co. has plans under way for extensions and improvements in its local gas plant, to cost about \$150,000, with machinery. The work will include new generating equipment, gas holder apparatus, etc.

Colorado

DENVER—The Radium Co. of Colorado and the Carnotite Products Co. have been merged under the name of the first noted organization. Headquarters will be maintained at Denver, and it is said that plant facilities will be increased.

Delaware

WILMINGTON—The United States Flashless Powder Co. is reported to be planning for the rebuilding of the several units at its plant, recently destroyed by fire. An official estimate of the loss has not been made.

Florida

TAMPA—The Southern Glass Mfg. Co. has plans under way for the construction of a new glass-manufacturing plant in the vicinity of Bartow, Fla., to be 1-story, 60 x 148 ft., with wing extension 36 x 100 ft.

Georgia

ATLANTA—The J. M. Tull Rubber & Supply Co., 84 North Pryor St., has awarded a contract to A. K. Adams & Co., Grant Bldg., for the construction of a new 2-story and basement plant. J. M. Tull is president and general manager.

SANDERSVILLE—The Sandersville Cotton Oil Mill is planning for the rebuilding of the portion of its plant destroyed by fire, May 20, with loss estimated at about \$100,000, including machinery.

Illinois

CHICAGO—The Advanced Forging & Tool Co., 35 South Dearborn St., has had plans prepared for the construction of a new 1- and 2-story plant at Central Park, near Addison St.

Indiana

COLUMBUS—The Indiana Oil Refining Co. has taken bids for the construction of its proposed new oil refinery on a local site, estimated to cost about \$500,000, with machinery. Preliminary work has recently been placed under way, including foundations for stills, condensers and other equipment. It is proposed to have the plant ready for operation in November.

Kansas

KANSAS CITY—The Kansas City Foundry Co., manufacturer of small metal castings, will defer the erection of the proposed 1-story addition to its foundry, 65 x 130 ft., at Water and Walker Sts. It is planned to build the structure early in the fall. E. C. Austin is secretary.

Maryland

BALTIMORE—The American Steel Rolling Co., 1203 North Charles St., is considering the construction of a new plant at Eighth and Monument Sts., for the manufacture of iron and steel rods and other rolled steel specialties. The plant will be electrically operated in the different departments, and will include a small open-hearth furnace. It is proposed to develop an initial annual capacity of about 15,000 tons of material, which will be increased at a later date. R. S. Baldwin is general manager.

BALTIMORE—The American Sugar Refining Co. has filed plans for the construction of a new 1-story brick and steel building, at Woodall and Clement Sts., 107 x 405 ft., to be used in connection with its new plant at this location.

Massachusetts

WORCESTER—The American Steel & Wire Co. has completed foundation work for its proposed new plant at its South Works, and will handle the erection of the superstructure by day labor. The plant will be 3-story, 144 x 120 ft., brick, steel and reinforced concrete, and is estimated to cost about \$150,000, with equipment.

FRAMINGHAM—The Dennison Mfg. Co., manufacturer of paper products, has construction under way on its proposed new 4-story and basement addition, 70 x 100 ft. The Aberthaw Construction Co., 27 School St., Boston, is the building contractor.

Maine

RUMFORD—The Rumford Pulp Products Co. has acquired a local mill, formerly used for magnesia production, and will remodel the structure for a new works for the manufacture of pulp products in the form of leatherboard specialties. Machinery for production will be installed at an early date.

Michigan

BAY CITY—The Wildman Rubber Co. has awarded a contract to the Bay City Stone Co. for the construction of the first unit of its new local plant, to be used for the manufacture of automobile tires and tubes, and other rubber products. The works will be 3-story and basement, 161 x 365 ft. It will be equipped for a production of about 2,500 automobile tires and 5,000 tubes per day. With the erection of additional units it is proposed to increase this capacity to an output of 50,000 tires and 100,000 tubes daily. W. W. Wildman is president.

GRAND RAPIDS—The E. S. Kiefer Tanning Co., Front St., is planning for the construction of a three-story addition to its tannery, 30 x 40 ft., estimated to cost close to \$20,000.

NILES—The French Paper Co. is planning for a number of extensions and improvements at its plant. A new power house will be erected.

ROCKWOOD—The Ford Motor Co. has commenced the installation of machinery at its new local plant, to be used for the manufacture of glass products for automobile service.

Montana

GREAT FALLS—The Anaconda Copper Mining Co., Anaconda, Mont., is considering the establishment of a new plant in the vicinity of Great Falls, for the manufacture of insulated copper wire products.

Nebraska

BURNHAM—The Burnham Brick Co. is considering the rebuilding of its local plant, partially destroyed by fire, May 16, with loss estimated at about \$100,000, including machinery.

New Jersey

MILLVILLE—The Millville Pulp and Pine Products Corp., 218-20 Walnut St., Philadelphia, Pa., E. H. Hults, president, is completing plans for the erection of its proposed new 1- and 2-story plant at Millville and Cumberland Roads, Millville. Bids for erection will be asked at an early date.

New York

NEW YORK—The Atlantic Gulf Oil Corp., 11 B'way., is planning for the operation of its new oil refinery at Southampton, England, now nearing completion, during the present month. The plant will be operated in the name of its subsidiary organization, the Atlantic Gulf Petroleum Corp. It will have an initial daily capacity of 3,500 bbl., and this output will be increased later to about 5,000 bbl. per day maximum. The new plant will represent an investment in excess of \$3,000,000. Franklin D. Mooney is president of the parent corporation.

Oklahoma

PONCA CITY—W. K. Moore and D. J. Donahoe, Ponca City, are organizing a company to establish a local plant for the manufacture of bricks and other burned clay products.

ONETA—The Oneta Refining Co., recently organized with a capital of \$250,000, is considering plans for the construction of a new oil-refining plant in the vicinity of Pine Bluff, Ark. Henry Miers, Oneta, is one of the heads of the company.

Oregon

PORTLAND—The Portland Vegetable Oil Mills, Inc., has filed plans for the construction of the initial unit of its proposed new plant at North Portland, to cost about \$150,000, including machinery.

Pennsylvania

PHILADELPHIA—The General Smelting Co., Stock Exchange Bldg., is taking bids for the erection of a new chemical plant at Bath and Westmoreland Sts., Emile G. Perrot, 329 South Broad St., is architect.

Tennessee

CHATTANOOGA—The Signal Mountain Cement Co. has taken bids for the construction of a new cement manufacturing plant, estimated to cost about \$200,000, with machinery.

Texas

FORT WORTH—The Edmonds Oil & Refining Co. has plans under way for additions in its oil refinery at Riverside, near Fort Worth, to increase the daily capacity from 2,000 to 3,000 bbl.

SAN ANTONIO—The Gulf Portland Cement Assn., 812 Gibbs Bldg., recently organized with a capital of \$3,000,000, is perfecting plans for the construction of its proposed new plant in the vicinity of Castroville, Tex. The new plant is estimated to cost in excess of \$500,000. W. S. Campbell is president and general manager.

THREE RIVERS—The Three Rivers Glass Co., recently organized, will soon commence the construction of a new plant for the manufacture of glass products. It is proposed to have the plant ready for operation early in the fall.

TEXAS CITY—The Bennett Petroleum Co., Houston, Tex., is planning for the construction of a new petroleum plant in the vicinity of Texas City, to cost about \$100,000 with equipment. The company has a 12-acre site in this district.

BRECKENRIDGE—The Absorption Gas Products Co. has plans under way for the establishment of a chain of plants for gasoline absorption operations. The initial works will be located in the vicinity of Breckenridge, and will have a capacity of 7,000,000 cu.ft. C. C. McCandless is engineer.

West Virginia

WILLIAMSON—The Williamson Red Brick Co. has commenced the erection of

additions to its plant for increased production. New equipment will be installed.

PAKKERSBURG—The Davis-Wolfe Oil Co., recently incorporated with a capital of \$100,000, has taken bids for the construction of a new local works, for the production of petroleum and petroleum byproducts. Robert E. Davis, Box 611, heads the company.

New Companies

THE SUPERIOR BRASS WORKS, INC., Detroit, Mich., has been incorporated with a capital of \$40,000 to manufacture brass and bronze castings and other kindred metal products. The incorporators are Frank M. Klump, Bedford, O.; Carl W. Thurmes and John M. Burke, 262 Chalmers Ave., Detroit.

H. C. BEBBINGTON & CO., INC., Trenton, N. J., has been incorporated with a capital of \$100,000 to manufacture steel products. The incorporators are Herbert W. Backes, C. T. and Harry C. Bebbington, 221 East Hanover St., Trenton.

THE CARBONIZED FIBER PRODUCTS CORP., New York City, has been incorporated with a capital of \$110,000 to manufacture fiber specialties. The incorporators are J. A. Roegman, W. R. Respass and L. F. Stumpf, 233 B'way.

F. P. LARMOYEAUX & SON, INC., Clarksburg, W. Va., has been incorporated with a capital of \$10,000 to manufacture glass products. The incorporators are Felix Larmoyeaux, Isa W. Monroe and G. H. Duthrie, Clarksburg.

THE J. A. C. PRODUCTION CO., 481 North Vermillion St., Danville, Ill., has been incorporated with a capital of \$50,000 to manufacture refined oil products. The incorporators are C. W. Ames, G. H. Schultz and D. W. Osborn.

THE INTERNATIONAL MICA CO., Chicago, Ill., has been incorporated under Delaware laws with a capital of \$250,000 to manufacture mica products. The company is represented by William J. Dole, 140 North Dearborn St., Chicago.

TIP PORTLAND MFG. CORP., New York City, has been incorporated with a capital of \$55,000 to manufacture paints, varnishes, etc. The incorporators are A. Oberbeck, C. Flatman and P. Gross, 302 B'way.

THE CHARLESTON EXTRACT CO., Charleston, W. Va., has been incorporated with a capital of \$200,000 to manufacture chemical products. The incorporators are E. B. Brown and O. P. Fitzgerald, Charleston.

THE ALBALOID NOVELTY CO., Newark, N. J., has been incorporated with a capital of \$100,000 to manufacture composition products. The incorporators are Henry Stuhler, Max M. Albach and Joseph Sobel, 55 New Jersey Railroad Ave.

THE WEISS OIL CORP., 220 South State St., Chicago, Ill., has been incorporated with a capital of 2,500 shares of stock, no par value, to manufacture oil products. The incorporators are Harry L. Meyers, H. Latzar and Edwin P. Swatek.

THE AMERICAN SOAP POWDER WORKS, Brooklyn, N. Y., has been incorporated with a capital of \$20,000, to manufacture soaps and kindred products. The incorporators are G. Silkworth, J. Leon and H. W. Van Alen, 215 Montague St., Brooklyn.

THE GULFTEX REFINING CO., Dallas, Tex., has been incorporated with a capital of \$100,000, to manufacture refined oil products. The incorporators are William White and Russell Reynolds, Dallas.

THE CLIMAX RUBBER CO. OF N. J., Newark, has been incorporated with a capital of \$1,000,000 to manufacture rubber goods. The incorporators are William J. Gilberts, Warner S. Rexford and J. Phillips Tarr, 120 Firemen's Bldg., Newark.

THE PERSSON LABORATORIES, Mount Clemens, Mich., has been incorporated with a capital of \$50,000, to manufacture chemicals and chemical byproducts. The incorporators are John H. Collins, Detroit; William T. Kelly and Gustaf A. Persson, Mount Clemens.

THE CHARLES MCADAM CO., Chicago, Ill., has been incorporated under Delaware laws with a capital of \$500,000 to manufacture paints, varnishes, etc. The company is represented by A. E. Manheimer, 10 South LaSalle St., Chicago.

THE C. E. ROGERS BRASS FOUNDRY CO., 64 Plympton St., Boston, Mass., has been organized by the estate of C. E. Rogers, to manufacture brass and bronze castings.

THE ELIZABETH DYE & CHEMICAL CORP., Elizabeth, N. J., has been incorporated with a capital of \$250,000, to manufacture chemicals, dyes and affiliated products. The

incorporators are James W. Roper, W. S. Knowlton and Dr. Paul Straus, Elizabeth.

THE MUTUAL PETROLEUM CORP., Adrian, Mich., has been incorporated with a capital of \$25,000, to manufacture refined mineral oil products. The incorporators are Charles A. Shierson, William E. Shierson and Rolland C. Rothfuss, Adrian.

THE GENERAL CHINAWARE CORP., New York City, has been incorporated with a capital of \$850,000, to manufacture china-ware products. The incorporators are Charles G. Atwood, William Hardman and Lewis H. Rogers, New York. The company is represented by Leonard E. Wales, Equitable Bldg., Wilmington, Del.

THE RESERVE PETROLEUM CO., Tulsa, Okla., has been incorporated with a capital of \$100,000, to manufacture petroleum products. The incorporators are J. R. Hill, Tulsa; and J. L. Kimmerl, Muskogee, Okla.

THE CONSOLIDATED PAPER CO., Monroe, Mich., has filed notice of organization to manufacture paper products. The company is headed by John C. Bullis, I. A. Newcomer and Albert H. Lockwood, Monroe.

THE PERRY & DERRICK CO., Dayton, Ky., has been incorporated with a capital of \$30,000, to manufacture paints, varnishes, etc. The incorporators are A. J. Grosser and F. J. Derrick, Dayton.

THE MAR-BELL PRODUCTS CO., Asbury Park, N. J., has been incorporated with a capital of \$100,000, to manufacture lime, cement and affiliated products. The incorporators are Ira A. Clayton, Joseph P. Watson and Joseph G. McDonough, 500 Main St., Asbury Park.

THE EL DORADO REFINING CO., El Dorado, Ark., has been incorporated with a capital of \$60,000, to manufacture refined oil products. The incorporators are W. J. Brown and William Wood, El Dorado.

THE AMERICAN LYSOFORM CO., New York City, has been incorporated with a capital of \$10,000, to manufacture chemicals, drugs and kindred products. The incorporators are C. H. Stange, H. W. Richter and J. M. Clark. The company is represented by Katz & Summerich, 120 B'way.

THE GLOBE MFG. CO., Worcester, Mass., has been incorporated with a capital of \$20,000, to manufacture celluloid and composition products. The incorporators are Henry and Simon Silverman and Samuel Wolfson, 54 Jackson St.

THE MACDOUGAL PROCESS CO., Niagara Falls, N. Y., has been incorporated with a capital of \$200,000, to manufacture electrochemical products. The incorporators are J. G. Rowe, R. H. Bennett and A. J. MacDougall. The company is represented by Kellogg, Babcock & Sullivan, Buffalo.

THE H. J. FLEMING PAPER CO., Philadelphia, Pa., has been organized by Harry J. Fleming, Frank C. Sayre and Harry R. Axelroth, 416 Walnut St., to manufacture paper products. H. J. Fleming, 1630 Pine St., is treasurer.

THE DUZ CO., New York City, has been incorporated with a capital of \$175,000 to manufacture washing and cleansing powders, and kindred chemical specialties. The incorporators are C. A. True, A. G. Thorne and M. E. Graef, 68 Winfield Ave., Jersey City, N. J.

THE UNION BRONZE CO., Reading, Pa., has been incorporated with a capital of \$50,000, to manufacture brass, bronze and kindred metal products. Robert P. Fritch, Reading, is treasurer.

THE EL DORADO OIL CORP., Paragould, Ark., has been incorporated with a capital of \$100,000, to manufacture oil products. The incorporators are H. S. Trice and W. G. Graves, Paragould.

THE CALIFORNIA GYPSUM CO., Los Angeles Cal., has been incorporated with a capital of \$1,500,000, to manufacture gypsum products. The incorporators are E. P. Wiley, Edwin K. Alpaugh, San Gabriel, Cal.; and C. H. S. Russell, Culver City, Cal.

THE DOMINO SHORTENING CO., 1615 First National Bank Bldg., Chicago, Ill., has been organized to manufacture oils, compounds and affiliated products. The company is headed by H. A. Timmins, E. S. Waterbury and M. E. Smith.

THE M. & M. OIL CO., Buffalo, N. Y., has been incorporated with a capital of \$30,000, to manufacture refined oil products. The incorporators are G. P. Manning and C. P. MacArthur, Jr. The company is represented by Penney, Killen & Nye, Ellicott Sq., Buffalo.

THE ROBINSON LIME CO., Winchester, Tenn., has been incorporated with a capital of \$250,000, to manufacture lime and kindred products. The incorporators are

Arthur J. Robinson, C. G. Ferris and W. S. Claiborne.

THE DERRICK OIL CORP., Jamestown, N. Y., has been incorporated with a capital of \$100,000, to manufacture petroleum products. The incorporators are W. J. Olson, H. S. Holmes and C. E. Nelson. The company is represented by R. H. Jackson, Jamaica, L. I.

Capital Increases, etc.

THE IMPERIAL PAINT CO., 50 Tenth St., Long Island City, N. Y., has filed notice of increase in capital from \$50,000 to \$100,000.

THE BOHEMIA BRICK & TILE CO., Houston, Tex., has filed notice of increase in capital from \$125,000 to \$250,000. A. T. Eddington is head.

THE PERFECTION TIRE & RUBBER CO., Marquette, Bldg., Chicago, Ill., operating a plant at Fort Madison, Ia., has filed notice of increase in capital from \$15,000,000 to \$20,000,000.

THE CARTERET OIL CO., Jersey City, N. J., has filed notice of increase in capital from \$1,500,000 to \$1,750,000.

THE BRADFORD-BROWN PAINT CO., Houston, Tex., has filed notice of increase in capital to \$40,000.

THE WORCESTER ABRASIVE CO., a Delaware corporation, has filed notice of organization to operate in New York, with a capital of \$300,000. H. S. Holmes, 1661 B'way., represents the company.

THE BROOKLYN FOUNDRY CO. INC., Orchard St., Brooklyn, N. Y., has filed notice of increase in capital from \$25,000 to \$100,000.

THE AMERICAN MALLEABLES CO., Lancaster, N. Y., has increased its capital from \$1,000,000 to \$2,000,000.

Coming Meetings and Events

AMERICAN CHEMICAL SOCIETY will hold a meeting at Rumford Hall, Chemists' Club, New York City, on June 19.

AMERICAN CHEMICAL SOCIETY, THE SOCIETY OF CHEMICAL INDUSTRY and the American Section of the latter society will hold a joint meeting in New York, Sept. 6 to 10.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Lake Placid, N. Y., Sept. 29 and 30, and Oct. 1.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its spring meeting June 20 to 24 at Detroit. Industrial excursions will be made to Ann Arbor, Saginaw, Midland and Bay City.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its eighteenth annual meeting at the Hotel Ambassador, Atlantic City, June 9, 10 and 11.

AMERICAN MINING CONGRESS AND NATIONAL EXPOSITION OF MINES AND MINING EQUIPMENT will hold its twenty-fourth annual convention in the Coliseum, Chicago, Oct. 17 to 22.

AMERICAN SOCIETY FOR STEEL TREATING will hold its third annual convention and exhibition Sept. 19 to 24 at Indianapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its 1921 annual meeting in the New Monterey Hotel, Asbury Park, N. J., during the week of June 20. Technical sessions are scheduled as follows: Tuesday, on Preservative Coatings and Textiles; Wednesday, on Cement, Concrete and Road Materials; Thursday, on Ceramics, Lime and Gypsum, on Petroleum Products and on Testing Methods; Friday, on Metals.

THE NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (SEVENTH) will be held during the week of Sept. 12 in the Eighth Coast Artillery Armory, New York City.

NATIONAL FERTILIZER ASSOCIATION will hold its twenty-eighth annual convention at the Greenbrier Hotel, White Sulphur Springs, W. Va., the week beginning June 20.

NATIONAL LIME ASSOCIATION will hold its annual convention in New York City June 15 to 17.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stettens Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF CHEMICAL INDUSTRY (BRITISH) at the invitation of the Montreal section will hold its annual meeting in Montreal and other Canadian cities during the week of Aug. 29, 1921. Details will be printed in this magazine from time to time.